



Jeff
Passan

The Arm

Inside the
Billion-Dollar
Mystery of the
Most Valuable
Commodity
in Sports

“This is the most important
baseball book in years.”
—John Smoltz, former
Cy Young Award winner

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DEDICATION

FOR RICH, WHO GAVE ME THE BUG.

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PROLOGUE

FOR 130 YEARS, PITCHERS HAVE thrown a baseball overhand, and for 130 years, doing so has hurt them. Starter or reliever, left-handed or right-handed, short or tall, skinny or fat, soft-tossing or hard-throwing, old or young—it matters not who you are, what color your skin is, what country you are from. The ulnar collateral ligament (UCL), a stretchy, triangular band in the elbow that holds together the upper and lower arms, plays no favorites. If you throw a baseball, it can ruin you.

When the UCL breaks, only one fix exists: Tommy John surgery. Over the past decade, the procedure became a frequently uttered curse word as pitcher after pitcher felt the pain of a torn ligament, huffed anesthesia a few days later, and woke up an hour after that with a fresh scar and an exasperating rehabilitation schedule. Some of the biggest names in Major League Baseball needed Tommy John. Even more kids, some barely teenagers, blew out their elbows and underwent surgery. At the highest levels of the game, a panic swelled. Not only were the arms of current pitchers failing, elite players from the next generation were going down before they could sign their first professional contract.

The culture of baseball seemed backward to me. The more I thought about the pervasiveness of Tommy John, the more I understood it needed demystifying. I heard stories of kids getting Tommy John surgery at fourteen years old. (They were true.) And of kids who underwent Tommy John even when they weren't hurt, because they thought it would help them throw harder. (Neither the stories nor the implication was true.)

Mostly, I wanted to understand this for my son. He was five years old. He loved baseball. He wanted to play catch every day. He was hooked, like his dad. And the more I heard stories from other parents—of their sons getting hurt or boys they know quitting baseball because their arms no longer worked—the more I needed to figure out what was happening to the arm.

So I spent three years traveling the world to find out. I saw a mad scientist in rural Florida who believes he can fix the arm and a couple of geniuses in Chicago who saw fit to spend more than \$15 million on one. I went to Seattle to watch a human being throw a baseball almost 106 miles per hour and to Kansas City to see a teenager flirt with 100. I flew to Arizona to get Sandy Koufax's opinion on the greatest sports orthopedist ever, asked that orthopedist how he came up with Tommy John surgery in the first place, and learned from Tommy John himself how he once worried that his hand was going to be permanently clawed because of it. I sat in laboratories, saw doctors tend to bodies living and dead, went halfway across the globe to a place where the problem is even greater, read medical studies, and scavenged through data, all to answer two vital questions:

How did baseball fail the pitching arm, and what can be done to save it?

Eventually, I found two pitchers who allowed me to infiltrate their lives at their nadir so I could fully understand what happens when an arm—and a career—blows up. Daniel Hudson was twenty-five when his UCL burst. He threw differently from most, his arm slot a low three-quarters, his release almost like a slingshot, each pitch stoking the cauldron's fire. Even so, the Arizona Diamondbacks had never bothered tinkering with his mechanics. A pitcher is fine until he isn't. The other pitcher, Todd Coffey, was a right-handed reliever with a personality as big as the scar on his elbow. He needed two Tommy John surgeries, the first when he was nineteen, the next at thirty-one. A study on two-time

Tommy John patients showed that the ligament from Coffey's first surgery lasted the longest of any pitcher who needed another surgery. This didn't guarantee his return from the second. Nothing can.

I marveled at Hudson's and Coffey's daily existence, which toggled between triumph and failure. They balanced loneliness and tedium with excitement and redemption. Optimism got into daily head on collisions with reality. These two men are the faces of every arm. And yet before I tell their stories it's important to understand the arm's place in the rest of the baseball world and what's at stake beyond billions of dollars and World Series titles.

The problem is not going away. The sport's foremost doctors believe it's worsening. The current generation of pitchers is lost, the product of a broken system, their arms ticking time bombs. If that doesn't change, today's kids will be the next casualties. They throw more and harder at younger ages than ever. Do the same thing again and again and again, and no matter how natural—like many things about the arm, the idea that throwing is an unnatural motion is a complete myth—it will break.

I don't want that to be my son. I don't want that to be your son. Baseball knows it needs top-to-bottom change. The \$1.5 billion Major League Baseball spends annually on pitchers' salaries is five times more than the combined cost of every starting quarterback in the NFL. It exceeds the top two hundred NBA salaries put together. When I call the pitching arm the most valuable commodity in sports, it is not an exaggeration. And yet the most overanalyzed sport in the world, with an industry of bright minds studying its intricacies, loses half a billion dollars a year to injuries. More than 5 percent of pitchers end up on the disabled list every season, on average for two months—plus, and one quarter of major league pitchers today wear a zipper scar from Tommy John surgery along the elbows.

People in the sport call arm injuries an epidemic. Solutions do exist. They aren't easy, and they take the sort of overhaul baseball seems loath to implement, but they can happen. Because one thing we now know is that for all of its travails, all the heartache it can cause, all the frustration left in its wake, the arm is capable of wondrous things.

CHAPTER 1

A Dead Man's Tendon

HE DIDN'T WANT A PIECE of the dead guy holding his elbow together. That's all he asked.

Todd Coffey had resigned himself to spending the next year learning how to throw a baseball again. He had accepted the mind-numbing rehabilitation process after tearing his ulnar collateral ligament, the two-inch elastic band that had prevented the upper and lower bones of his right arm from flying apart when he pitched. He simply couldn't stomach the new ligament coming from someplace other than his own body. "I think about it as a used car that has 40,000 miles on it," Coffey said. "You don't know what the previous 40,000 miles were like. I don't know what it's been through."

He had spent his entire adulthood in baseball. Got married, had kids, fought his way to the major leagues, made his first million and a few more, played the hero and the goat. Now his elbow had popped, and it was fix it or be done. He was used to binary outcomes after spending nearly half his life as a relief pitcher. Ball or strike. Win or loss. Save the game or blow it. He knew nothing else. He didn't want to know anything else. And here he was, at thirty-one, with that career, that life, at risk, and the doctor wanted to reconstruct his elbow with a dead man's tissue because Coffey's own body didn't have any to spare.

On July 17, 2012, Coffey slid into an MRI tube at the Kerlan-Jobe Orthopaedic Clinic in Los Angeles. The next day he was scheduled to undergo Tommy John surgery, the procedure that revolutionized baseball in 1974, when Dr. Frank Jobe used a tendon from the wrist of John, a left-handed pitcher, to replace his torn elbow ligament. At the time, Jobe said it had a 1 percent chance of success. In the forty years since, the procedure has saved nearly one thousand professional players' careers, including that of Todd Coffey. It had given Coffey everything, and now it was threatening to take it away. Coffey was a well-traveled reliever, having bounced from Cincinnati to Milwaukee to Washington to Los Angeles, and now to Dr. Neal ElAttrache's operating room.

Nobody needs a pitcher with arm problems, not when there are kids in the minor leagues who can throw harder and come cheaper. While Coffey wanted again to be among the 80 percent whose careers Tommy John surgery saves, a second procedure poses far more risks. Revisions, as they're called, aren't nearly as successful. Compound that with the possibility of foreign tissue mending Coffey's elbow and a ripped tendon in his forearm that required repair, too, and even ElAttrache warned that there was no typical sew and go.

"This," he said, "is the toughest Tommy John I've ever done."

Were it up to ElAttrache, he would've skipped the MRI and gone straight to an allograft, the technical name for a tissue transplant from a cadaver. Coffey insisted, so the MRI machine growled and confirmed what ElAttrache had thought: maybe, just maybe, there would be sufficient tendon in his left leg for a graft. It probably wasn't twelve centimeters, the minimal length needed, and the scar tissue from the previous surgery might have compromised its integrity. Discouraged, Coffey asked ElAttrache to cut into his leg and poke around for something better anyway. Coffey would know only when he awoke from the anesthesia whether he might join the short list of major leaguers striking o

batters with an elbow not entirely his.

On the morning of the surgery, Coffey was supposed to arrive at seven thirty. He showed up a half hour early at Kerlan-Jobe with his wife, Jennifer, and his mother-in-law, Cathy Singer. Palm trees swayed in front of the five-story building plopped in the middle of West LA. Celebrities and athletes and everyday people mingle daily in the third-floor waiting room, burying their heads in magazines and smartphones before appointments with ElAttrache. Coffey plopped into an old chair and started to fill out paperwork. The signatures seemed endless. Coffey didn't bother reading the documents. His eyes drooped. He hadn't slept very well. Stan Conte, a trainer for Coffey's team, the Los Angeles Dodgers, slipped into the room and pulled Jennifer aside.

"How is Todd?" Conte asked.

"He kept saying he didn't want to have surgery," she said.

Coffey didn't know what to feel. His livelihood mocked him. It wasn't just the allograft. Jennifer, his second wife, was five months pregnant with their first child, and Coffey wanted to come back in twelve months whereas the doctors said it was going to take eighteen, and, God, was the rehab brutal and what if the surgery didn't go well and kept him from even trying to come back, which didn't happen much, but maybe it would happen to him. And the dead guy. Please, Doc, not the dead guy.

He buried his head in the papers, looped his signature, tried not to listen.

"Time to go," a nurse said.

Coffey leaned over and gave Jennifer a kiss. She told him everything would be OK, and he wanted to believe her.

"I love you," he said.

The nurse whisked him through a door and back to an operating room, where ElAttrache soon would join them. Todd Coffey's career was not dying, not there, not then. Neal ElAttrache promised he'd save it.

THE FIRST TIME TODD COFFEY'S UCL blew, the surgeon tried to harvest the palmaris longus, a tendon from his right wrist, to tie the elbow back together. The tendon was too thin to stabilize the joint. He sliced open the other wrist. Same problem. So he went to Coffey's left leg and removed the gracilis, a hamstring tendon. It broke as the doctor tried to loop it through Coffey's elbow. One more cut yielded a fresh gracilis. Mercifully, it worked. Coffey made history on May 11, 2000: He was the first—and still the only—patient in the history of UCL reconstruction to go in for a surgery that entailed two cuts and leave with five scars.

Over his fourteen years in the game, Coffey had left behind an almost-unparalleled trail of apocryphal stories that were actually true. Like the time he asked the Arizona Diamondbacks' visiting clubhouse manager to make him a sandwich. He wanted peanut butter on one side, jelly on the other, two Reese's Peanut Butter Cups in the middle, all griddle-fried with butter. To this day, visiting players at Chase Field still can order the Todd Coffey Sandwich. His new teammates always wondered about the extra piece of luggage he hauled from city to city. The hard-shelled suitcase carried just one item: Coffey's baseball glove.

Justin Todd Coffey was born September 9, 1980, in Shelby, North Carolina. He stands six feet four, weighs approximately three hundred pounds, and has a shock of red hair with a beard to match. Fans know him best for his exuberant sprints from the bullpen to the pitcher's mound, during which many of those three hundred pounds gyrate in manners only physicists can explain, and which tens of thousands of YouTube viewers have enjoyed. For seven years, he clawed through the minor leagues

the twelve-hour bus trips and fast-food dinners in bunk-ass towns for nothing pay and even less hope. Eventually, he found a role as a bullpen piece for the Cincinnati Reds, where he became a clubhouse favorite. Although he is smarter than his goofy persona might suggest, Coffey fits the stereotype of a man playing a kid's game: he still drinks whole milk, watches *Star Trek*, and obsesses over Blood Bowl, a football-rugby hybrid dice game that involves painting figurines and having them disfigure one another.

Coffey's career had been far better than most, even if instability defined it. His career earnings totaled nearly \$7 million as an average reliever for eight years. Cincinnati had released him on his birthday in 2008, and the Milwaukee Brewers and Washington Nationals subsequently let him walk via free agency, and his current Dodgers contract would expire at the end of 2012, leaving him jobless for the first time since a Reds executive tried to talk him out of signing as a seventeen-year-old. It was another of Coffey's odd stories. After Cincinnati chose him in the forty-first round of the 1998 draft, the team wanted to watch him pitch in junior college for a season and, if he looked good, sign him for a far more significant bonus before the next draft. To show their best intentions, the Reds asked area scout Steve Kring to pay Coffey a visit after the draft.

"I sent the scout into the house to go ahead and offer him a thousand dollars," said DeJon Watson, the Reds' scouting director at the time. "There was no bonus. It was just the minor league contract. And he fucking accepted it! The scout's calling me from the house, freaking out. I said, 'Did you explain to him we want him to go to college and give him more money later on?' And he said, 'Yeah. He doesn't care.'"

Watson had already spent every dollar budgeted for the draft by his skinflint owner, Marge Schott, and did not want to draw her ire for dropping even a thousand dollars on a forty-first-round pick from North Carolina who threw 88 miles per hour. He started screaming at Kring.

"D," Kring said, "Todd wants to talk to you on the phone."

Watson figured he could convince Coffey to go to college. He sweet-talked his way into deals. Surely he could sweet-talk his way out of one. Watson told Coffey he was excited to have him in the Reds family and that everyone wanted to see him grow as a pitcher—in college. To which Coffey replied that he'd rather sign. Watson thought Coffey didn't understand. He did. He understood clearly. He just refused to listen. Coffey was signing his contract.

"And I promise you," he said, "I'm gonna pitch in the big leagues."

He reported to Billings, Montana, one of eight future major leaguers on the Reds' rookie-ball team. He didn't throw hard, not yet. He was awkward, Watson said, "like a big Baby Huey at the time. They teased the shit out of him. I felt so bad. Everybody rode him so hard." Coffey stomached the jokes, kept improving, gaining velocity, fighting through his first Tommy John recovery, not just making it but staying. "It was something special about him," said Watson, who later helped bring Coffey to Los Angeles, where he was an assistant general manager. "He said he was gonna pitch in the big leagues. And he kept his end of the bargain."

Coffey loved pitching for the Dodgers. They had spent most of the first three months that season in first place. Dodger Stadium was paradise for pitchers. The sale of the team to a Magic Johnson-backed consortium invigorated the city. When Coffey came into the game in relief in the top of the eighth inning against Cincinnati with his team down 3–1 on July 2, 2012, he figured it would be just like his previous 460 appearances in the big leagues: throw sinkers and sliders, get ground-ball out of the head home. On Coffey's fifth pitch, a slider that plunked his former teammate Jay Bruce on the foot, he felt a twinge in his elbow. He shook his arm and thought little of it. Coffey bounced his next pitch into the dirt. His catcher, A. J. Ellis, visited the mound.

“Something doesn’t look right,” he said.

“It feels fine,” Coffey said.

“You’re not extending,” Ellis said.

“I will, I will,” Coffey said.

Three pitches later, Dodgers outfielder Elian Herrera misplayed a Todd Frazier hit into a triple. Manager Don Mattingly headed to the mound with the team’s head trainer. Coffey threw a couple of warm-up pitches, and even though he shook his arm after each, he swore he was good, and the trainer believed him.

Coffey struck out the next two hitters. He still has no idea how.

“Maybe adrenaline?” he said. “My elbow was done. And the tough thing is, in my case, it didn’t hurt. I didn’t have any pain. There’s no swelling. It just felt like normal inflammation. My body was telling me: You can pitch.”

He gave up a hit on his next pitch, and Mattingly yanked him and sent him into the clubhouse. ElAttrache, the Dodgers’ team physician, could examine him. Coffey is almost certain his elbow blew out when he hit Bruce, meaning he fired sixteen pitches, most up around 92 miles per hour, with a UCL shredded for the second time.

An MRI the next day confirmed the tear. The misery of Tommy John surgery had struck Coffey again, as it would strike at least twenty more pitchers through the end of 2012. Even if his career in Los Angeles was done, Coffey promised to follow the Dodgers the rest of the season. He swore he would not forget them, no matter where he was or what he was doing.

Coffey needed just one favor before he left and went on to the rest of his career. He asked for Mitch Poole, the home clubhouse attendant, to wrap up his spikes. He wasn’t going to waste a perfectly good pair of shoes, not when he planned on using them again.

THERE WAS BLOOD ON THE floor of the stark-white Operating Room 2 at Kerlan-Jobe, and the surgeon hadn’t even started. Coffey, who hated needles, had warned the staff about his elusive veins. “I’ve always been a hard stick,” he said. “My veins hide.” On the first attempt at inserting an IV in Coffey’s arm, the vein blew and spurted crimson. It took three more tries before an IV worked.

Coffey breathed deeply. At least he wouldn’t have to watch the rest. The nurse warned him he would feel some burning. Propofol, the creamy white sedative doctors call “milk of amnesia,” started to course through Coffey’s body.

The door opened and ElAttrache walked in.

“Doc,” Coffey said. “This is some good shit.”

“We’re going to get you taken care of,” ElAttrache said.

“Well, good luck,” Coffey said, drifting off to sleep. Once he was out, the medical team covered everything except his right arm with a sheet. ElAttrache first needed to assess the havoc. Years of damage can leave a pitcher’s elbow looking like a grenade went off inside. ElAttrache started the scalpel above Coffey’s first Tommy John scar on his upper arm, sliced over the elbow and ended beneath the bottom of the old scar—about twelve inches total, four inches longer than with a first-time UCL patient. He split the muscles around the elbow and used retractors to expose the UCL area—a inscrutable mess of red muscles blending into ligaments mingling with tendons camouflaging bone. ElAttrache needed to navigate the mess, and the first task called for someone even more specialized than him.

Dr. Steve Shin worked as a hand surgeon at Kerlan-Jobe, and ElAttrache needed his precision. Shin

looked into the exposed elbow and prepared his one assignment: move an eight-inch portion of Coffey's ulnar nerve, a tube of fibers that originates at the spine, snakes down the arm, and controls fine-motor movement in the hand. The ulnar nerve allows you to pinch, make a fist, type. A hand is a hand, and not a claw, because of it. Even the slightest bit of irritation to the nerve can have a profound effect; since Coffey's first surgery, the numbness in his ring finger and pinky hadn't abated. Not only could mishandling of the nerve set back his rehab schedule, it could leave him with permanent damage, barely five minutes into the surgery.

Shin wore a pair of jeweler's loupes in order to distinguish the nerve and its tiny branches from the surrounding scar tissue. During Coffey's first operation, the surgeon, Dr. Timothy Kremchek, had brought the ulnar nerve to the front of the elbow, laying it over the reconstructed ligament, a procedure that in the dozen years since had fallen out of favor. Shin, a kind of neural cat burglar, carefully lifted the nerve away from the disarray inside Coffey's arm and fastened it temporarily to his skin with three sterile rubber loops weighted down by clamps. The ulnar nerve would rest there, a spectator to the rest of the operation, which at ten a.m. was barely under way.

Now ElAttrache could gauge the true damage, and it was grim. An MRI provides a working theory on an arm's condition, though it rarely tells the entire truth. In 2012, Minnesota Twins pitcher Scott Baker went in for surgery on the flexor-pronator mass, a bundle of muscles in the forearm, and went out with a new ulnar collateral ligament, too. ElAttrache feared Coffey's flexor mass had ripped away from the bone and torn his flexor tendon, and his suspicion was correct. Now an already trying surgeon would prove a test of ElAttrache's patience and stamina as much as his technical know-how.

"Stan, look at this," ElAttrache said, calling over the Dodgers' trainer, who had scrubbed in. The last twelve years of pitches had turned Coffey's elbow into spaghetti, and the flexor tendon torn because of what Stan Conte calls "shearing force"—the minute stresses that, when repeated thousands upon thousands of times, can cause ligaments and tendons to fray and, eventually, to snap.

ElAttrache wasn't exaggerating when he called this his toughest surgery. Hundreds of Tommy John operations have earned him the title of the fastest gun in elbow reconstruction, powering through some UCL repairs in as little as sixty minutes. His preferred technique requires drilling holes to create new pathways in the humerus (upper arm) and ulna (one of the lower-arm bones) through which he can slide the tendon until perfectly taut. Over the next two years, the new tissue slowly undergoes a process called ligamentization, in which tendon cells called tenocytes modify their function and how they secrete the regenerative protein collagen, and, after about two years, change their entire form. Adapting to its new role holding the upper and lower arms together, the tendon actually morphs into a ligament, connecting bone to bone.

ElAttrache went to work, asking for pickups—medical tweezers—and a scalpel. The last track of Counting Crows song strained through a subwoofer and two cube speakers. Conte stepped away from the table. He had sat in on plenty of surgeries, and he never tired of what they represented: a miracle of modern medicine that could give injured pitchers a new lease on a baseball career. Even with Tommy John's success rate, he didn't shrug it off as some routine procedure—"almost like a root canal," as Atlanta Braves manager Fredi González once called it.

"A lot of people talk about Tommy John, how you're back in twelve months," Conte said. "It's not that easy. There are complications. There are issues. There are a ton of decisions to be made in the OR that can change things. It's like we're walking up to the tee right now and the hole is five hundred yards away. This is our tee shot.

"And I hope nobody shanks it."

EVERYBODY IN THE ROOM STOOD except for Neal ElAttrache. He sat in blue scrubs on a swiveling stool with a green surgical mask over his mouth. Although Todd Coffey's arm was flayed open, all eyes were on ElAttrache, who happens to have movie-star looks and a clientele to match. Earlier in 2012, a picture of Arnold Schwarzenegger and Sylvester Stallone resting in adjacent hospital beds had gone viral. ElAttrache had done their surgeries back-to-back. Schwarzenegger went to him on the recommendation of ElAttrache's brother-in-law: Stallone. He is married to the model Jennifer Flavin and ElAttrache to her sister Tricia, a nurse he met on his first day at Kerlan-Jobe twenty-five years ago. Tricia doesn't see much of him, nor do their three daughters. He misses parent-teacher conferences and lets mom handle boy trouble. Sleep is a luxury for ElAttrache, golf a rarity. He is fifty-four, in the prime of his career, the prime of his life, and he spends most of his time tending to other people's problems. When Los Angeles Lakers star Kobe Bryant blew an Achilles, ElAttrache fixed it. When Los Angeles Dodgers ace Zack Greinke fractured a collarbone, ElAttrache mended it. He performed both of those surgeries the same April day in 2013. Hundreds of millions of dollars ride on his scalpel.

"I always have to take care of my patients and do surgery and do that well. That trumps everything else," ElAttrache said. "That level of intimacy, that relationship you make with a patient, celebrity athlete or not, is almost like a sacred thing. I tell the guys we're training: if that privilege doesn't strike you right in the chest, to have that given to you, you're missing the most beautiful thing about what we do. It doesn't matter how famous they are. It's that you can really be involved in someone's life."

Orthopedics called him, as it did his father, Selim, who attended Jesuit school in Lebanon as a kid, studied medicine in France, and came to Chicago in the mid-1950s to complete his residency at Northwestern University. He didn't know much English, so he learned by joining a local YMCA for three months. He met a nurse named Vera, got married, graduated, moved to Utah, started a family, and relocated to Pittsburgh, where he took care of the United Mine Workers. Three of his children would grow up to be doctors. Neal was the famous one. When he gave lectures around the country, his father sometimes showed up unannounced and snuck into the back row for a listen.

"My first day in medical school, my first class in anatomy, I knew I had been blessed to find maybe the only thing I'm any good at in my life," ElAttrache said. "I feel very, very fortunate to have been able to find it. I immediately knew I was home."

More than an hour into the surgery, ElAttrache laced sutures through the holes he had drilled in Todd Coffey's humerus and ulna to help guide the graft and, ultimately, hold it in place. The ends of the sutures stuck out like guitar strings that hadn't been clipped.

ElAttrache conducts his team like he's leading an orchestra, his hand movements signaling exactly where the other half-dozen people should be and what they should be doing. When he opens his hand, his scrub tech, Ken Newmark, knows what instrument ElAttrache needs. When he releases the tourniquet, Leslie Quinn, his nurse, is standing over the wound with a suction instrument. When he readies to drill into a limb, his equipment tech, John Hale, hands him a tool loaded with the proper bits. The movement of the team is balletic.

At 10:44 a.m., with the ulnar nerve resting safely to the side and the preliminary holes drilled and the sutures strung, ElAttrache started spelunking for whatever piece of the gracilis might be left. He ran his scalpel along Coffey's thigh. Tourniquets allowed the flesh inside to remain a pearly white. ElAttrache wasted no time in jamming his index finger into the hole. As he rooted around, ElAttrache pushed the skin of Coffey's leg out from the inside. "It's all feel," Conte likes to say. ElAttrache

wasn't feeling much and asked for help. Shin and a surgical fellow each pulled back one side of Coffey's leg to give ElAttrache a better look. When doctors need something, they will MacGyver. And if it meant Coffey's leg was going to hurt like mad when he woke up because two grown men were playing tug-of-war with it, well, he's the one who rejected the dead man's tendon, and that's what pain meds are for, anyway.

The extra leverage proved no help; no matter how much ElAttrache searched, he couldn't find what he was looking for.

"I shouldn't have to dig this out," ElAttrache said.

"It's melted down," Conte said.

Quinn, the nurse, knew what that meant. She went over to a workstation near the operating table and came back with two eight-and-a-half-by-eleven sheets of paper and showed them to ElAttrache.

"There are two choices here," she said. "You like any one better?"

She held one piece of paper in her left hand and the other in her right. ElAttrache scanned the left first, then went to the right.

"Give me that one," he said, pointing to Quinn's left hand.

As Quinn left the room, ElAttrache dug back into Coffey's leg. It was 10:56. He had already spent twelve minutes fishing. He wanted to search one more time so he could tell Coffey he made every effort. Quinn walked back in, holding a blue bedpan filled with warm water and a plastic bag with a long, white strand inside.

"You want it open?" she asked ElAttrache.

"Not yet."

A minute later, he found what he was looking for: the last remnant of Coffey's left gracilis. ElAttrache slung his fingers behind it and pulled the tendon out of the wound to show the onlookers.

"I can see through it," ElAttrache said.

"That's not great tissue," Conte said.

"This would be the weakest link of our operation if we went with that," ElAttrache said.

Nothing is as critical during Tommy John surgery as the length and diameter of the graft. Having a good piece of tissue emboldens a doctor. Had ElAttrache used Coffey's remaining gracilis, it may not have been enough to tie even a single loop, let alone the double-stranded approach ElAttrache preferred. He gestured toward the bedpan and said to Quinn: "Open it."

At 10:58 a.m., she sliced through the bag and pulled out Todd Coffey's new elbow ligament. Quinn dipped it in the water and let it continue to thaw as ElAttrache stitched together Coffey's leg and laid a few Steri-Strips over the sutures. Six minutes after its water bath began, the allograft was ready.

If Todd Coffey wanted to pitch again, it would be with the semitendinosus tendon of Donor ID 101079556, a twenty-four-year-old male who'd died in a car accident. Nobody in the room knew his name. Coffey's new tendon (cost: three thousand dollars) had arrived vacuum sealed from RSC Biologics in Gainesville, Florida, packed in dry ice inside a cooler stuffed into corrugated cardboard. It was just another brown box among the many dropped off at Kerlan-Jobe, a frozen miracle to undo what years of pitching had wrought.

The tool kit for ElAttrache's standard UCL replacement includes sutures made of collagen-coated polyester-wrapped plastic polymer, stainless-steel alloy drill bits manufactured to eat through bone without burning it, chamfers to round off sharp edges of bone that could slice the fresh tendon, and the battery-powered Arthrex 600 drill. ElAttrache stood above Coffey, ready to begin the most delicate phase of the surgery: drilling two holes in the ulna that intersect like a V in the middle of the bone. The graft would come in one side and out the other. Then both ends would slide into a 5.0-millimeter

tunnel on the bottom of the humerus, where two smaller drill holes on the top of the bone would create separate paths for the two ends, which would be yanked taut by the sutures ElAttrache laid earlier. Once the tension was correct, ElAttrache would knot the sutures together on the outside of the bone, stabilizing the new UCL.

The tiniest error could end Coffey's career. During Coffey's first Tommy John, this was a ho-hum portion of the proceedings, but in a revision—particularly one lasting this long—maintaining bone integrity presented the greatest danger. Forget baseball being a game of inches. Surgery dabbles in fractions of millimeters. The drill holes from Coffey's first surgery left his ulna in danger of cracking. ElAttrache needed holes small enough to ensure the bone's stability and large enough to accept the thick graft. Already he had shaved down the semitendinosus to accommodate it. He took a deep breath, sucking in his mask, and leaned in toward the ulna, ready to fix Coffey's elbow using the docking method, a variation on Jobe's original surgery.

As he depressed the drill's trigger, ElAttrache used a guide to stop the bit from plunging too far. "I have to be careful on the ulnar side," he had explained earlier. "I don't want to break the bridge." The bridge is the area between the two holes. The bigger the bridge, the less likely the bone is to crack. If the bone did fail, ElAttrache could attach the UCL with a metal button or screw, an inferior solution. Broken bone meant no more baseball.

Immediately ElAttrache knew the 3.5-millimeter holes in the ulna were too small. He took away the guide and free-handed one hole to a 3.6-millimeter width. He tried to pull the graft through. Not even close. He didn't want to thin it any more, either. Most blowouts leave most of the original UCL in place; the surgeon can tie the new tendon on top of it, using the native ligament's collagen to help in the healing process. Coffey's had practically vaporized, the remaining pieces infinitesimal.

ElAttrache asked for a 4.0-millimeter bit. As Hale prepared the drill, ElAttrache debrided tissue from the bone. Shin, the hand doctor, suctioned away the refuse. ElAttrache wanted a closer look. The bridge was getting smaller by the moment, the peril growing larger.

"I'm ready," ElAttrache said. He widened the holes to 4.0 millimeters and tried to pass the graft again. It wouldn't budge. He was getting pissed. In a normal surgery, he could drill the ulnar tunnel with his eyes closed. He asked for a 4.5-millimeter guide but kept the 4.0-millimeter bit. The slightest mistake meant total failure, and ElAttrache was inviting it by free-handing the drill to expand the tunnel's opening by that fraction of a millimeter.

"That's high-tech art right there," Conte whispered. "Notice how quiet it got? Everyone knows this is technically difficult."

The drill buzzed and emerged with a bloodied bit. It was 11:31. A normal Tommy John surgery takes seventy-five minutes. This had already gone twice as long, and it wasn't close to done. Dusty Volkmer, a surgical fellow at Kerlan-Jobe, continued filming the procedure and snapping pictures with an iPhone. ElAttrache couldn't remember another revision with a blown flexor mass, so he wanted to document it for future such cases, rare though they may be.

"Graft," ElAttrache called. Quinn retrieved it from the bean-shaped pan. ElAttrache tugged at it. Still nothing. "Fat part of the graft," he said.

Then, finally, movement.

"Here it goes," ElAttrache said. "Here it goes."

The room perked up.

"A little oil?" he said. "I do not want to break this thing."

Quinn, the nurse, squirted a dab of mineral oil where graft met tunnel. The tendon started to slide.

"Whew!" ElAttrache said.

Sutures pulled the graft through the ulna and out the second hole. ElAttrache looped it into the humeral tunnel and used two more sutures to guide them down their respective paths. He measured where he needed to trim the tendon so it would fit perfectly, detached both ends from the sutures, and removed it from Coffey's elbow.

No longer was the allograft white. Blood covered it as ElAttrache began trimming it to size. He admired the finished product. "I love the length," he said. After using the titanium chamfer to smooth the ulnar tunnel, ElAttrache once again slinked the tendon through, this time for good. He knotted the sutures strong and true.

The hard part was over. At 12:12, just as the Dodgers were about to take the field a few miles away, ElAttrache tied the final three knots. He lifted Coffey's limp arm in the air with the help of two others. He bent it at the elbow and rotated it in and out, like Coffey does on every pitch. If the graft slacked, ElAttrache would need to start over.

"OK," he said, "feel that."

"Whoa!" Shin said. "That's tight!"

ElAttrache sutured the new UCL to the remaining shreds of the old one. A suction tube drained away a river of blood. Every few minutes, Quinn cleared blood clots and tossed them into a biohazard wastebasket nearly filled to the brim. ElAttrache moved down to the flexor mass, the muscles that connect the elbow to the wrist, and began to fix their torn tendon and reattach them. The dried blood on his gloves was almost black. He took a deep breath and groaned. "My ass is numb," ElAttrache grouched.

He had been parked in the same swivel chair for three hours. ElAttrache gently carried the ulnar nerve to its new location, away from the bone and protected by subcutaneous fat, a precaution to keep it away from bone chips that could develop, sever the nerve, and leave the hand useless.

ElAttrache hooked the first stitch to close Coffey's wound at 12:48. He cinched the final one six minutes later. After nearly four hours, Todd Coffey had a new arm.

JENNIFER COFFEY SAT IN THE chair closest to the waiting-room door, glancing at it every few minutes, hoping ElAttrache would walk through and assure her everything had gone well. She played a slot machine app on her iPad to pass the time. Her whole morning felt like a game of chance.

She was a newly minted baseball wife, five months pregnant but barely showing. She felt the awful cocktail of nerves and fatigue. Coffey had kept her up most of the previous night, asking rhetorical questions, catastrophizing—the dead guy and what comes next and life without baseball and on and on and on.

"You think one thing," Jennifer said, "and your mind takes you further and further into the future. Not just now, but once he starts playing again. How many years does he have left to play? He has to be precise and particular and so careful. One more thing goes wrong and he's done. I don't know anyone has had a third Tommy John. I think the more it happens, the less likely you are to return."

It wasn't just his career causing her the agita. Where would they have the baby? Pasadena, where they moved for the summer? Phoenix, where Coffey would rehab? Milwaukee, where she grew up? Rural North Carolina, their offseason home? Their wedding gifts were in Wisconsin still, and she wasn't going to be able to travel soon, and—she stopped midsentence. The door into the waiting room opened. ElAttrache and Stan Conte appeared.

"He did great," ElAttrache said.

She sighed.

“He has a very big graft,” ElAttrache said. “The only issue was I wasn’t able to use his own tissue. It was precariously short. And I could see through it. It was a little bitty thing. This was much better tissue.”

“On my son, in that circumstance, I would’ve used the allograft,” Conte said. “I think that’s the best chance for him to get back. It really is.”

“The allograft—is his body going to accept it?” Jennifer said.

“When you transplant his own tendon, there are still some living cells that emit chemical signals to attract blood vessels and things like that,” ElAttrache said. “The same thing is going to happen on this, in the environment it’s in, because it’s a very vascular environment. That process may be a little slower. We don’t know that clinically, but we think it’s correct. It’s definitely safe tissue to use. And it works.”

“So,” Jennifer said, “when will he be back?”

“I don’t see this being a twelve-month return to competition,” ElAttrache said. “And based on the time of the year, the chances of him making it back for next season aren’t good. He just needs more time.”

Jennifer would deal with their onerous year ahead soon enough. After nearly five hours, she just wanted to see her husband. She thanked ElAttrache and Conte and headed back to the recovery area where Coffey, supine on a bed, was regaining consciousness. He wore a hospital gown and booties on his feet. He would leave two hours later with pain meds to be taken every four hours. Best of all, his fingers weren’t at all numb from the handling of the ulnar nerve.

The first question Coffey asked Jennifer wasn’t about the dead guy. He knew it had been likely and he’d get used to it. Nor was it about the rehab. His relentless optimism told him he would be back in twelve months, and so he’d aim for twelve months. And it wasn’t about the baby, or how Jennifer was feeling, or where they would move, or anything of that ilk. Like Neal ElAttrache, Todd Coffey was a man who kept his promises. And the day his elbow failed, he had made a promise to his teammates that he’d never forget them. Not even Propofol could break it.

He looked at Jennifer, smiled, and asked: “What’s the score?”

CHAPTER 2

Dummyball

DOCTORS CONSIDER TOMMY JOHN SURGERY one of the most successful medical procedures ever because it solved a problem. When an elbow ligament tore, it could be fixed. Baseball rejoiced. “We thought elbows were solved,” former Red Sox general manager Ben Cherington said. “So we stopped thinking about them.”

Because an answer for elbow issues existed, the sport never bothered to concern itself with the root cause of such injuries. Maybe it was mechanics, the way a player throws the ball and its effect on his body. Perhaps it was usage, the volume of pitches or innings in a single game, over a whole season, or even longer. Certainly a player’s genetic makeup could factor in, too, or how hard he threw, or what pitches he preferred, or his between-start workouts, or his diet, or any other sort of measurable factor.

Tommy John surgery, it turned out, was a paradox, the procedure that worked too well. It lulled baseball into a false sense of security, and by the time the sport realized what had happened, an epidemic was on its hands. Elbows are breaking more than ever and younger than ever. And while the rash of Tommy John surgeries that spread across Major League Baseball over the last five years took out some of the game’s finest pitchers, children ages fifteen to nineteen make up a disproportionately high number of patients. Baseball is thus left scrambling to figure out how to keep its million-dollar arms healthy while fixing a feeder system that keeps sending damaged goods to major league teams.

“It’s a huge issue,” said Rob Manfred, Major League Baseball’s commissioner. “You know why it’s a huge issue? Because that’s a competitive space, and the single biggest competitive advantage baseball has in that space is the fact that it may be the safest sport your kid can play. It still doesn’t mean that we don’t have a responsibility to make the play of the game as safe as possible for kids. And we do. We take that seriously.”

Over the last two decades, baseball’s youth apparatus has been filched and privatized, and the single-sport-specialization craze has transformed the game. The best players spend most weekends year-round traveling to tournaments across the country. They participate in so-called showcase events in which maximum-effort throws and pitch velocities that light up radar guns separate the elite from the rest.

In hindsight, the results were predictable. Stephen Strasburg, the right-hander with a 102-mph fastball who shattered signing-bonus records out of college, blew out his arm twelve games into his rookie season with the Nationals. More big names followed: New York Mets ace Matt Harvey, Miami Marlins wunderkind José Fernández, Texas Rangers star Yu Darvish.

Latin American countries, where the best kids spend their early teen years playing baseball for a living so they can cash in with bonuses at sixteen, were hardly spared: Iván Nova and Danny Salazar from the Dominican Republic, Martín Pérez and Carlos Carrasco from Venezuela, even José Contreras, the forty-year-old Cuban. Every day, it seemed, another went down. During one two-week span early in the 2014 season, nine players underwent Tommy John.

The number one pick in the draft two months later, Brady Aiken, didn’t sign with the Houston

Astros because of an abnormality in his elbow and eventually needed Tommy John. Two more first round picks in 2014, Jeff Hoffman and Erick Fedde, were chosen despite their blown-out elbows, and potential number one picks in 2015 (Michael Matuella) and 2016 (Cal Quantrill) underwent Tommy John while still in college. “It’s almost like it’s a sci-fi film where they’re going to take the best and the brightest with a light ray coming down,” Oakland Athletics GM Billy Beane said. “The ligaments remaining are the ones you don’t necessarily want pitching for you.”

Arm injuries are nothing new. In the days of three hundred– and four hundred–inning seasons, plenty of pitchers were injured. Sports medicine, in its nascent stages, had next to no understanding of how the arm worked. Salaries were minuscule, and the cost of losing a player was negligible. Today, the science for progress exists. It’s lunacy to call arm injuries the cost of doing business when the business loses hundreds of millions of dollars as a result of them annually. Baseball nevertheless has fostered an environment in which all thirty teams treat pitchers’ health as proprietary information instead of banding together to solve the sport’s greatest mystery. “Teams are hesitant to invest because they think they’re going to seed the money and then everyone is going to share in the information,” New York Yankees president Randy Levine said. Competition gets in the way of the greater good, greed in the way of greater health, and any advances that could rejigger the system at lower levels stay in-house. “This is one where you need the it-takes-a-village approach,” Beane said. “We’ve got to stop pretending we know the answers. Because whatever we’re doing doesn’t seem to be working.”

As injuries piled up, teams panicked and started treating their best young players with kid gloves. In 2012, the Toronto Blue Jays sent their three top pitching prospects—Noah Syndergaard, Aaron Sanchez, and Justin Nicolino—to Class A Lansing. Syndergaard looked like a Nordic god, six feet six and 240 pounds, all muscle and blond hair. Sanchez was a six-foot-four twig with lightning in his right arm. Nicolino typified the command-and-control left-hander who kills batters softly.

For their first five starts of the season, each was limited to three innings pitched. This seemed senseless. No studies showed that unusually short outings keep pitchers healthier long-term. The restrictions felt similar to the thinking that limits most current major league starters to around one hundred pitches: a guess. I emailed then–Blue Jays general manager Alex Anthopoulos and asked what the team was handling young arms with restraint bordering on alarm.

“Overall, there’s not much science to what we do,” he wrote. “Just being overly cautious with our young arms. We have no evidence that shows it’s the right way to go but we prefer to err on the side of caution.”

Never before had I heard Anthopoulos, a studious sort whose analytical bent helped him land his job, admit to making a choice about vital pieces of his franchise’s future with “no evidence.” He personified a game spending a billion and a half dollars a year on something it didn’t understand.

Baseball is a constantly evolving sport, challenging itself and its entrenched beliefs with rigorous self-examination. The current trend toward defensive shifts stemmed from a simple, epistemological question: What is a position? No boundaries define it, so why confine players to certain areas when the numbers show hitters deposit balls in certain pockets more often than others? The game struggles more with macro questions. It’s why baseball has now settled on the reductive strategy for handling pitchers: throw them less. The fallacy of treating something as unique as a pitcher’s arm collective may be the acme of baseball senselessness.

Here’s the truth: they’re scared. And maybe they should be. A new generation of kids raised in travel-ball and showcase culture is throwing harder than ever, and the results are troublesome. “UC reconstruction is becoming a victim of its own success,” wrote Brandon J. Erickson, an orthopedic

surgeon, for the *American Journal of Orthopedics*, “as younger and younger athletes who will like never play at the major league level are undergoing this procedure at an alarming rate.”

For a 2015 paper, Erickson used a supercomputer to access a private medical database that cataloged five years’ worth of injuries. He typed in code 24346—UCL reconstruction with a tendon graft—and found 56.8 percent of cases were performed on teenagers. Surely some suffered from delusions of grandeur, others from overeager surgeons, but the reality of the numbers frighten those baseball who understand what’s happening.

This problem is only getting worse.

AT A YOUTH-BASEBALL COMPLEX SOUTHEAST of Phoenix, a ten-year-old boy named Harley Harrington stood on top of a mound and twirled pitch after gorgeous pitch. Harley’s motion was a study in biomechanical beauty, his legs driving efficiently, his hips swiveling at just the right time, his non-throwing arm tugging down and pulling through his torso, and his right arm unfurling so smoothly it looked machine-taught. His peers chucked the ball; Harley delivered it.

He came here in March 2015 from San Diego with a traveling baseball team called the Show, which recruited some of the best ten-and-under kids in Southern California to compete in high-level tournaments like this one, the Spring Championship Super NIT in Gilbert, Arizona. Hundreds of other teams in all age groups, some as young as seven years old, came from around the country to feed the excesses of American youth baseball personified by the Big League Dreams complex. Built near a farm, it reeked of cow dung. Local politicians still kick themselves for spending more than \$40 million to develop the campus for the private company that runs ten more such facilities across the West Coast.

Four fields, each built in the scaled-down image of a famous major league stadium, surrounded a central hub of video games, flat-screen TVs, bad food, and, most important, copious beer. The tap started flowing around eight a.m., when some fathers lubed themselves to forget they’d been connected into traveling hundreds of miles for games that just as easily could’ve taken place ten minutes from their houses. The youth baseball–industrial complex can hypnotize even the most mindful.

Nicola and Martin Harrington never expected to find themselves in a facility like this. Nicola once was a pop star in England whose band, the Simon Cowell–backed Girl Thing, fizzled amid great hype. Much of the drama involved Nicola’s secret relationship with Martin, a music producer. They were married, had Harley, left England, and ended up in Los Angeles, where a friend of Martin’s told him that now that his boy was American, he needed a baseball glove. Harley fell in love with the game and showed enough aptitude that he craved better competition.

All Martin knew about the United States’ travel-sports industry—whose estimated revenues now range from \$7 billion to far more—was that it seemed crazy. Not just the cost of hotels or the time away from work, all so a kid could play at a novelty stadium or win a cheap championship ring, but the children on other teams who cowered in fear of criticism from their parents.

Three former number one overall picks in Major League Baseball’s draft had played for the Show: National League MVP outfielder Bryce Harper and two pitchers, Stephen Strasburg and Brady Aiken, both of whom bear scars on their elbows. While Harley started as an outfielder, his coaches quickly recognized the fluidity with which he threw a ball. Pitchers spend a lifetime trying to look as natural pitching as Harley did the first time he stepped on a mound.

“Having been around some really good players in our program, sometimes we single out kids who remind us of others,” said Hector Lorenzana, one of the Show’s longtime coaches. “We had the

privilege of having Bryce Harper since he was eight and a half, nine years old. We see flashes of things kids do at certain ages. And it reminds you of other players who have come through. Harley is one of those.”

At the Spring Championship Super NIT, whose champion qualifies for an even bigger tournament later in the year at Disney World, the Show ran roughshod through its bracket to reach the semifinals where it unleashed Harley. He mixed fastballs and off-speed offerings, all from the same release point, each pitch faster and crisper than his peers’. Harley exited in the fourth inning after fifty-two pitches, well short of the tournament limit of eight innings with no maximum pitch count. Martin always kept track of how many Harley had thrown, and when the Show squeaked out a victory to go into the finals, he approached Lorenzana about Harley’s availability for the next game.

“Going in the same day back-to-back,” Lorenzana said, “is a huge no-no for us.”

And yet Martin Harrington, conscientious enough to download an app to track his son’s usage, voracious enough reader to realize that the rash of Tommy John surgeries points back to excessive and unnecessary throwing by children, wanted his son to pitch in the final game, if need be.

“It’s not like it was the morning and there was a four- or five-hour gap,” Martin said. “To me it was about two hours, and he’d thrown fifty pitches. I thought it wasn’t a problem to throw twenty more. Honestly, I don’t think the Show is going to abuse a kid to win a medal. That’s not how they’re going to do it. But he had more left in him. Harley is one of those kids where he has unfinished business. He doesn’t need to show them he’s the best. But I think he felt shortchanged in the semifinals. I knew he wanted to go out there and finish it off.”

Another coach lobbied Lorenzana, too, pointing to Harley’s parents. “Look at the mom! Look at the dad!” he said. Both were pictures of fitness. Also working in Harley’s favor was that unlike almost every top travel-ball player, he actually took time away from baseball, spending his summers in England or playing club soccer. The single-sport-specialization malady that affected kids across the US landscape did not apply.

Still, nobody knew. Not Lorenzana, not Nicola or Martin Harrington, not the doctors urging coaches and parents to pump the brakes on excessive use. Nobody could say whether putting Harley back for a second time would cause damage years down the road. Every kid and every arm is different.

At 4:15 p.m., in the fifth inning of a blowout game the Show led, about two and a half hours after he had last pitched, Harley Harrington went back out to win a tournament for a group of ten-year-olds.

“If it was anyone other than Harley, we’d have shied away from it,” Lorenzana said. “There are some horses you’re going to ride a little longer. There’s no science. There’s no process. You just don’t know.”

INCREASINGLY, RESEARCHERS ARE LOOKING BEYOND the major leagues and down to kids like Harley Harrington and how they’re being handled. Grave concern exists among those studying the arm the way because of tournaments like the Super NIT, which lack pitch counts, the current generation of injured arms will look positively healthy compared with the kids’ coming up.

The American Sports Medicine Institute (ASMI), the baseball industry’s foremost think tank, followed nearly five hundred youth-league pitchers for a decade starting in 1999 and found that kids who pitched more than one hundred innings in a calendar year were three and a half times likelier to get injured than those who didn’t. In 1997, Dr. James Andrews, the famous orthopedic surgeon who had founded ASMI in Birmingham, Alabama, was performing Tommy John surgery on one or two high school kids per year. Today, he estimates he does eighty or ninety a year. “Hell, I’ve got four t

do tomorrow,” Andrews said during an April 2015 conversation. He fears that even worse news is coming at the major league level. “If they don’t get involved in it from a prevention standpoint at the youth level,” he said, “they’re not going to have anybody to draft out of high school or college who hasn’t had their elbow operated on.”

The future generation of baseball pitchers lives in a system that takes undeveloped and underdeveloped arms and pressures them to show off for the radar guns they’re taught will determine their future. The easiest way to build velocity is through year-round throwing—and year-round throwing, according to the ASMI study, is the single highest predictor of future injuries among kids. Risk factors are highest for kids like Harley, whose arms are especially fragile at ten years old and, in many cases, remain so through the end of high school and beyond. Some surgeons have performed Tommy John on kids as young as thirteen years old, even as doctors at the top of the field warn against cutting still-growing arms. Children who regularly pitched with arm fatigue are thirty-six times likelier to undergo elbow or shoulder surgery, another study by Andrews and his peers at ASMI found. The same study said that kids who pitch in games more than eight months of the year need surgery five times as often. And another study, published in the *American Journal of Sports Medicine*, reported that children like Harrington who play travel ball are five times likelier to suffer from elbow pain.

“I have this conversation with every Tommy John patient,” said Dr. Orr Limpisvasti, a surgeon at Kerlan-Jobe in Los Angeles. “Just so you know, I’m going to fix your arm so you can destroy it again. And this lightbulb goes off. Here’s what we know: Throwing is bad for your arm. You’re good at it and love doing it. And you tore your God-given UCL, probably the best one you’ll ever have by a long shot, and if we put a new one in, you’re refurbishing it so you can do the exact same thing that you did before.”

UCL reconstruction is far from foolproof, too. The procedure involves cutting through skin and muscle, drilling into bone, and tying the elbow together. It is major surgery that calls for a brutal and monotonous rehabilitation. And while the return rate is around 80 percent, a study from Jon Roegel in the *Hardball Times* looked at the return of every pitcher who underwent Tommy John surgery from 2000 to 2009 and found the median threw just sixty games and one hundred innings for the rest of his career. The data also showed that pitchers on fourteen-to-sixteen- and seventeen-to-twenty-month timetables had performed better than those who rushed back, an indictment against a baseball culture intent on returning pitchers in a year.

There is nothing glamorous about Tommy John surgery. The urban legend of doctors performing it pre-emptively and prophylactically is unfounded. Forget another myth, too: the problem stems from kids throwing curveballs too young. Another ASMI study showed that curveballs cause less strain on the arm than the simple, humble fastball, whose greater velocity taxes pitchers more. In 2003, the average fastball in the major leagues didn’t crack 90 miles per hour. Today, it’s over 92, jumping annually for eight consecutive years and placing not just a physical burden on every kid who dreams of being a big leaguer but also a mental one: throw hard or your chances are grim.

So they travel like Harley Harrington, using pitch-all-you-want tournaments to ready themselves for the grind of their teenage years, when scouts will converge on showcase events to see kids who have been reared to do everything bigger, faster, harder.

“Travel baseball is completely different than it was twenty years ago,” said Paul DePodesta, now the chief strategy officer for the NFL’s Cleveland Browns after spending two decades in baseball front offices. “With all the showcases and these guys pitching, it’s not just when they’re seventeen. It’s when they’re fourteen and fifteen.” DePodesta has four kids, three boys. His second son, Evan, played

on an all-star team that was invited to a regional tournament in 2014. He got to stay in a hotel and ~~wanted to keep doing that with a travel team.~~ Sure, his dad said, except he might have to give up football and soccer and basketball.

“I don’t think I’m ready to choose,” Evan said.

“Well, you shouldn’t,” DePodesta said, “because you’re six.”

THE ULNAR COLLATERAL LIGAMENT IS a finicky little bastard, ill-equipped to stand up long-term to the single fastest movement the body can generate: the throwing motion. The arm moves thirty times faster than an eyeblink when it’s firing a baseball. It’s the final cog of a mechanism that steals energy from the legs, builds on it through the hips and butt, transfers it up the back and to the shoulder, and releases it with a whip of muscles and ligaments and tendons and bones that launch a five-ounce projectile at speeds of up to 105 miles per hour. It is beautifully chaotic and chaotically beautiful. It’s different in every arm, from Harley Harrington’s emergent one to that of Greg Maddux, the Hall of Fame pitcher who never did break over a twenty-three-year, five-thousand-inning career. All the gurus of biomechanics—the science, as the pioneering biomechanist James G. Hay once said, of “internal and external forces acting on a human body and the effects produced by these forces”—concur that Maddux’s delivery was perfect, though one could argue that perfect mechanics are more than a series of proper motions. Perfection is the ability of a pitcher to find a delivery that keeps him productive and healthy.

Pitching consists of six generally accepted phases: windup, stride, arm cocking, acceleration, deceleration, and follow-through. Throwing a baseball differs from all other athletic tasks. Footballs are about ten ounces heavier and require slightly dissimilar mechanics. Tennis serves and volleyball spikes come more over the top than most pitchers’ high three-quarters deliveries. Windmilling softball pitchers rarely need Tommy John surgery, because the force generated simply isn’t enough to rip the elbow apart.

Overhand throwing isn’t in and of itself the villain or culprit. “When you grow up, that’s what you do. We throw,” said Chris Carpenter, the former St. Louis Cardinals ace. “It doesn’t have to be a ball. It can be a toy, a Cheerio. You grow up, you chuck shit around. That’s what I did anyway.” Throwing is eminently natural, positively symphonic, an inevitable result of human evolution. What’s unnatural is throwing a five-and-a-quarter-ounce sphere ninety-plus miles per hour one hundred times every five days.

The traditional pitching motion starts with a leg lift into a stride. This activates what’s commonly known as the kinetic chain—a simplistic way of describing the sequential transfer of energy from body parts farther from the ball to ones closer. Something as simple as a leg lift starts building elastic energy, a type of potential energy that comes from the stretching of ligaments and tendons before it’s stored in muscles. When the stride foot lands, the muscles in the butt clench—scouts look for pitchers with big asses for a reason: they’re biomechanically advantageous—and start rotating the hips. Shortly thereafter, the muscles in the back activate, too, sending rapid signals from the brain to the muscles. Those nerve impulses open up calcium channels in the muscle. As calcium is released, muscles contract. The powerful contractions begin cascading up the chain to the torso. Good hip-to-shoulder separation—the opening of the hips while the torso stays in line with the plate, which creates even more elastic energy because hip rotation stretches its ligaments and tendons—is common in the hardest-throwing pitchers.

Front foot down, hips rotated, torso starting to twist, pitchers cock their arms and prepare for

twenty to thirty milliseconds of wonder. What happens next is difficult to see with the naked eye. The shoulder externally rotates, bringing the elbow forward, the hand behind the body, and the forearm almost parallel to the ground. All of the elastic energy rushes into the shoulder, loading the muscles and ligaments and tendons and bones, like a coiled spring pushed flat. The UCL is screaming for mercy, particularly in players whose weak shoulder muscles cannot withstand the onslaught of energy and spill it down to an already-loaded elbow. The UCL is triangular, and the energy affects each side differently; the posterior and transverse bundles, biomechanists believe, endure less stress, while the anterior—the side that in almost every injury is torn—is burdened to the cusp of failure.

When the ligaments and tendons tell the shoulder it cannot rotate further, the elastic energy turns into kinetic energy, and the shoulder sends it down the arm by rotating internally at up to 8,000 degrees per second. No movement in the body matches the internal rotation of the shoulder, and along with the extension of the elbow, it propels the arm forward.

“If you’re one-thirtieth of a second late or early, you’re basically, over time, doing damage,” said Brent Strom, the Houston Astros’ pitching coach. “And that’s how fine this thing is. It’s like hitting a golf ball. You’ve got to be right on time. Those that can maintain that timing can stay healthiest the longest.”

The UCL breathes a sigh of relief as the energy travels down the arm and through the ball. Shoulder muscles contract to help the arm decelerate safely, and the follow-through dissipates the remaining energy. And, if all goes well, pitchers do it ninety-nine more times that day.

Baseball has seen its share of anomalies who could throw 150 pitches without any arm soreness and regularly top 100 miles per hour without incident. R. A. Dickey, the Toronto Blue Jays’ right-handed knuckleball pitcher, a thirteen-year major league veteran, throws a baseball for a living without a UCL, which is not supposed to be possible. He does not know if he was born without one or it just vaporized at some point during all the innings he tossed in high school. He is not sure if the muscles in his arm learned how to contract to keep it stable. Dickey simply knows he is a freak. And freaks are confusing. They defy explanation. And they challenge the modern theories of the pitching arm, which hold it to be a delicate flower never to be mistreated.

“I believe it’s miraculous,” Dickey said.

Dickey isn’t wrong. Long before he mastered the knuckleball, he was a regular fastball pitcher able to run it over 90 miles per hour. His arm’s ability to function without a UCL is extraordinary, though, for that matter, every arm is a little miracle. It doesn’t take an outlier to appreciate the arm’s ability to survive the rigors of baseball.

“Every time I throw, it’s a train wreck,” then-Philadelphia Phillies starter Cole Hamels said on May 25, 2012. “I’m sore as heck. I don’t even want to know what’s going on inside me.”

Two months to the day after Hamels said that to me, the Phillies signed him to a six-year, \$140 million contract extension.

HARLEY HARRINGTON IS A LOT like a boy who grew up in San Diego a quarter century ago and later inspired hosannas to the beauty of his pitching. Even when Mark Prior spent afternoons in the backyard playing catch with his grandmother, his talent was obvious. He grew up to be the Vitruvian pitcher, ideal in every way until he wasn’t.

“I tried to tell people: ‘My mechanics are not perfect,’” Prior said. Nobody wanted to listen, of course, because baseball people are stubborn and Prior looked the part. He was six feet five, his 220 pounds perfectly distributed from his tapered torso to his strong legs. His delivery looked

symmetrical, with an upright trunk, easy pace, and soft landing, all so his right arm could ride a rounded pathway to his release of the ball. Prior was supposed to be the Chicago Cubs' savior. He threw his last major league pitch when he was twenty-five, kicked around in the minor leagues after shoulder surgery, flopped in a few comeback attempts, and wound up in a front-office job. Today, he's responsible for helping keep the San Diego Padres' minor leaguers healthy.

Was it his delivery? Too much throwing as a kid? Bad genes? The unnecessarily high pitch count he ran up as a Cubs rookie? A combination of all four? Something else that no one can name? Prior is the baseball horror story that frightens Nicola and Martin Harrington and every parent whose kid braves the pitcher's mound. Even if the unicorn that is a mechanically ideal delivery exists—one that spares the elbow in a motion that inherently stresses the elbow—so many other factors can derail it.

Harrington's teammates saved him from a stressful second outing by launching hits, including a mercy-rule-inducing home run to win the Super NIT. "The Harley thing could've easily blown up on us," said Lorenzana. Instead, another coach picked up Harley and swung him around while the rest of the team danced in their blue-and-orange uniforms. At the ceremony for their championship rings, the tournament organizer prattled on, ending with a prophecy for a group of ten-year-olds he'd never met: "I know these guys are destined for greatness."

The Harringtons drove back to San Diego that night. Harley took a week off from baseball. Martin wondered whether he had done the right thing, rationalizing that he never had Harley thrown even seventy pitches before, and that he never would consider leaving him in a full game and pitching him a day or two later. "It's one of those situations where if you feel like your kid is being abused for one reason or another, we wouldn't stand for that," Martin said. "If our kid isn't on the field playing, he's depressed. To us, it makes sense. To Harley, it's terrible. 'How can you not put me on the field?'"

Dr. James Andrews hears different versions of that same story almost every day, and he worries about the youth system's halfhearted effort to clean itself up. Tommy John surgery is not a panacea. The time it requires to rehab kids don't have, training they may not be prepared to handle, and maturity they almost certainly don't possess without parents and coaches emphasizing the importance of arm care.

"What twelve-year-old is going to say? 'Excuse me, coach, I'm feeling a little soreness in my elbow. I think it would be most prudent if I stopped now,'" said Dr. Glenn Fleisig, the research director at ASMI. "We have a kid who's on a travel team and is a good pitcher. He enjoys being a good pitcher. His parents enjoy it. And they have nothing but the best intentions. Same with the coaches. They all enjoy it. So here's this kid. He's pitching on a Saturday afternoon, and he's spent. And his mom and dad are rooting for him. And so is this girl. And they're winning four to two. So of course he's going to keep pitching."

Doctors believe almost every UCL tear is an accumulation injury—a ligament worn down over time that finally relents. Kids play today more than ever, and while the correlation with the spike in UCL injuries is obvious, many in the sport see the relationship as causative, too. "There are so many misrepresentations of our game and how it should be taught and how kids should play it," said Tom Clark, the executive director of the MLB Players Association. "I shudder at the thought of being told at thirteen years old to choose a sport because that would be my only chance to make it."

If there's any good news, it's that the elbow's loss has been the shoulder's gain. Shoulder injuries used to be the bane of baseball, ending careers far more often than elbows and causing nearly seven thousand disabled-list days as recently as 2008, according to research by Jeff Zimmerman of the *Hardball Times*. By 2014, the number dipped to fewer than three thousand, thanks in large part to innovative exercise programs that strengthened shoulder muscles. Unfortunately, ligaments cannot be strengthened, which leaves the UCL to fend for itself against the onslaught of more throws and

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