



# Saving My Knees

*How to avoid a total knee replacement*



Find out if biologic solutions to rebuild your knee can keep you active and help you avoid a total knee replacement.



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# About The Stone Clinic

The Stone Clinic in San Francisco, California is at the forefront of orthopaedic surgery. Headed by world-renowned orthopaedic surgeon, Kevin R. Stone MD, we have spent 30 years pioneering and refining minimally-invasive, biologic treatments to fulfill our mission of keeping athletes active for life.

Every injury is different, every individual unique. We see osteoarthritis not as an incurable disease but as a fixable condition, which is why we design comprehensive, customized treatment programs for each patient to stop the pain and return them to full activity.

We regenerate and rebuild, rather than replace with metals and plastics, using innovative surgical interventions to preserve as much of the natural biology of the joint as possible, often rebuilding with donor tissue to give our patients natural-feeling, long-lasting outcomes that avoid or delay the need for joint replacement.

Our world-class physical therapy and rehabilitation team is onsite and will be with you every rep of your recovery, managing the pace and quality of your outcome with supervision from the operating surgeon, to ensure you return to sports faster, fitter, and stronger than you were before your injury.



**Meet Dr. Stone**  
*(Guide Author)*

Kevin R. Stone, MD an orthopaedic surgeon at The Stone Clinic and also the Chairman of the Stone Research Foundation. He is a pioneer of advanced orthopaedic surgical and rehabilitation techniques to repair, regenerate, and replace damaged cartilage and ligaments and a leader in outpatient robotic surgery for partial and total knees.

Dr. Stone lectures around the world as an expert in cartilage and meniscal growth, replacement, and repair and holds over 50 U.S. patents on novel inventions to improve healthcare.

Dr. Stone uses anabolic therapy and other biologic techniques to work to preserve the natural biology of a joint, helping people avoid or delay an artificial joint replacement.

## The Meniscus Transplant Center

Dr. Stone is one of the world's leading experts in meniscus transplantation and a pioneer of biologic orthopaedic techniques. For over 30 years, he and his team have specialized in giving people back their vital meniscus shock absorbers, keeping the knee moving naturally and reducing the likelihood of a total knee replacement.

The Meniscus Transplant Center at The Stone Clinic is an international destination for meniscus transplantation, dedicated to the diagnosis, surgical implantation, and rehabilitation of people in need of meniscus tissue.

Learn more about  
The Meniscus Transplantation Center >

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# Why rebuild a knee naturally?

## Can I avoid total knee replacement?

### Total knee replacement numbers are increasing

As Baby Boomers stay active longer and young athletes push themselves harder than ever, we're becoming a nation of knee injuries. We're hard on our knees and we expect our joints to keep doing the activities we've always done.

Not surprisingly, the past two decades have seen a sharp rise in the number of total knee replacements performed in the USA. The latest figures record six hundred thousand surgeries a year, with demand projected to increase to three million by 2030.

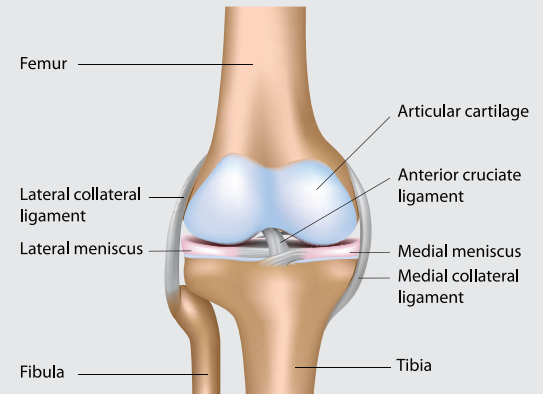
### It doesn't have to be this way

**Eighty percent (80%) of people told they need a knee replacement don't need one.** Even when there is bone-on-bone arthritis, most of the damage is in one part of the knee, and that part can be treated, resurfaced, or replaced alone. A partial knee replacement preserves more of the knee anatomy and feels more normal than a total knee replacement.

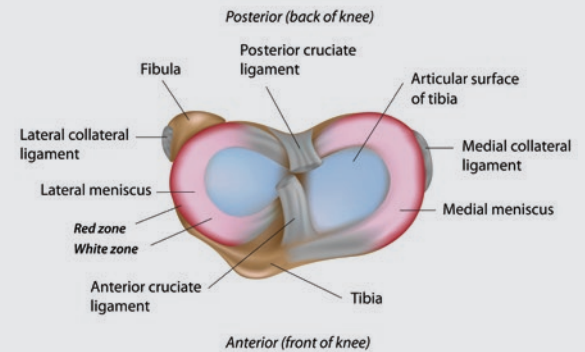
In cases where the bone is not resting on the bone, there are great alternatives that can help delay or avoid an artificial knee replacement. Operative solutions include replacing the meniscus cartilage, paste grafting the damaged articular cartilage, and reconstructing the ligaments called the BioKnee program.

Non-operative solutions include injection of bioactive factors, growth factors, lubricating hyaluronic acid, often with the addition of platelet-rich plasma to reduce inflammation and recruit stem-derived cells to the site of injury. We have an ongoing research interest and clinical program evaluating amniotic fluid as a rich source of active growth factors that potently reduce inflammation, reduce scarring, and may accelerate healing.

Anterior view of the right knee



Superior (top) view of the right knee



### KNEE ANATOMY

The knee is a remarkable construction. It extends, flexes, and rotates in a complex, coordinated fashion. It can bear forces up to five times your bodyweight. It's the largest joint in your body, connecting the femur (thighbone), tibia (shinbone), and the patella (kneecap). Four major ligaments attach bone to bone while the tendons attach the muscles to the bones.

There are two types of cartilage in your knee; the first is a fibrocartilage called the menisci (there are two, the lateral on the outside and the medial on the inside) which act as shock absorbers (or more accurately force diffusers) between the tibia and the femur. Once torn, or if partially removed, the forces of walking and running are concentrated in a smaller area on the tibia and thus lead to wearing of the articular cartilage down to the bone.

The second type of cartilage is articular cartilage, which covers and protects the ends of your bones allowing them to move smoothly. The articular cartilage is five times as slick as ice on ice as long as it is not injured.





## Small injuries can trigger big problems

We have learned that if injuries to the meniscus, articular cartilage, and ligaments are not repaired quickly, lead to arthritis. Joints generally do not wear out, even with extensive running, unless there is an injury. We believe that it is far better to repair, regenerate, or replace these injured tissues as soon as they are injured to prevent arthritis, to reduce the pain, and, hopefully, prevent the progression of arthritis.

## Decades of pain is unacceptable

Most patients diagnosed with arthritis are told that it can't be repaired. They are told to take pain medication and anti-inflammatory drugs, lose weight, cut back on their activities, and essentially wait until the arthritis is bad enough to warrant a knee replacement. Although a knee replacement can be a godsend after years of agony, they are not perfect and cannot be easily revised if they fail. Every decade is precious and we believe that there is no reason to live in pain when repair options exist. Most patients told they need a total knee replacement have excellent alternative treatment options such as a partial knee replacement, a biologic knee replacement, or a combination of anabolic injections plus physical therapy and fitness training

## What is a BioKnee?

A BioKnee is an alternative to an artificial knee replacement. It combines three key procedures that rebuild, regenerate, or biologically replace the damaged parts of the knee using donor tissues, a patient's own stem cells, and growth factors. This regenerative approach, harnessing the body's natural ability to heal itself, is the new frontier in modern medicine. The BioKnee has various combinations of meniscus repair with sutures, regeneration with a scaffold called a collagen meniscus implant (CMI) or replacement with a donor meniscus, articular cartilage paste graft repair, and ligament repair or reconstruction often with donor ligaments.

All of these procedures can be performed at one time. Some patients need all the tissues rebuilt and others are just missing one or two. As long as there is some joint space available our bias is to rebuild joints biologically before proceeding to a bionic or artificial implant solution.

## Patient Spotlights

Top athletes are unique people with drive to recover that inspires all of us. They push boundaries and teach us to reconsider what is possible.



### Tracy Porter, Super Bowl-winning Football Player

**Treatment:** *BioKnee - Meniscus transplant and articular cartilage paste graft*

Tracy etched his name in Super Bowl history intercepting a pass from the legendary Peyton Manning and returning it 74-yards for a touchdown—bringing the first-ever Super Bowl trophy to New Orleans.

The demands of the sport caught up with Tracy in 2011. Under the care of another surgeon, Tracy received a microfracture surgery and a meniscectomy commonly used in athletes with injured joints. While short-term results for these techniques often look promising, outcomes often tend to deteriorate over time, ultimately leading to bone-on-bone arthritis.

Tracy chose The Stone Clinic to repair his joint in 2017 after hearing Dr. Stone's game plan for naturally regenerating and rebuilding his knee. After a successful outcome with the BioKnee surgery including meniscus transplantation and extensive articular cartilage paste grafting, Tracy dedicated himself to rebuilding his knee strength and mobility under the guidance of The Stone Clinic physical therapy team. He is now living pain-free and performing at an intense level of physical activity not possible before.

Watch Tracy's Story



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## Articular cartilage regeneration

With a BioKnee, we first repair the articular cartilage, the white shiny surface that covers the ends of the bone. We've been doing this for over 25 years with a technique called Articular Cartilage Paste Grafting, which promotes the regrowth of cartilage inside the knee. In a single-step procedure, we take stem cells from your own bone marrow and mix them with harvested cartilage cells to form a paste. When the paste is packed into the damaged area of the joint, it is able to regrow cartilage repair tissue (lab data shows the formation of the paste increases the cellular activity of the cartilage cells to ramp up their healing ability. The cells dramatically increase the production of extracellular matrix. Clinical data and multiple biopsies show excellent repair tissue and improvement in pain and function lasting on average 17 years in over 80% of cases so far.)

## Meniscus repair, regeneration or replacement

Another BioKnee procedure repairs, regenerates, or replaces the meniscus, the shock absorber in the knee joint. A damaged or missing meniscus leads to increased forces across the knee and causes arthritis. We have developed new techniques to repair the meniscus, bringing in new blood supply to the torn tissue and often adding growth factors, recruiting stem-derived cells, and adding blood clots to augment healing—even in older people.

When only a portion of the meniscus is missing, we add a collagen meniscus implant (CMI) (which Dr. Stone invented in 1989) to act as a regeneration template for meniscus regrowth. When we can't repair or regenerate the meniscus, we replace it with a donor meniscus. We now have over 500 meniscus transplants in patients since 1995.

## Ligament reconstruction

Another BioKnee replacement solution is to fix damaged ligaments in order to properly stabilize the knee. We are able to repair, reconstruct, or replace these ligaments often using donor tissue. For people who have had a failed ACL reconstruction, we often notice that the corners of the knee joint are loose.



**Emily S,**  
**Ironman Triathlete**

**Treatment:** *BioKnee - Meniscus transplant and articular cartilage paste graft (2010)*

Emily is an Ironman distance triathlete and a lifetime ski-racer. Years of activity had destroyed her meniscus cartilage, and since the injured meniscus had not been repaired, it also resulted in articular cartilage damage. Emily had a BioKnee replacement consisting of a meniscus transplant and an articular cartilage paste graft in 2010. Within a year of the surgery, she trained for and completed her fourth Ironman and did the whole race only eight minutes slower than her previous pre-surgery time.

By 2012 Emily also completed two double-century bike rides. Emily says "Dr. Stone's surgery has been a revelation to me, it's totally enabled me to continue being who I am which is way more than just the sports that I do It's part of my personality and I'm thrilled."

We have followed Emily's progress over the years as part of our outcome study on meniscus transplants in athletes. Since her surgery, she has completed 6 Iron Man races, Heliskies, and skies powder regularly. Her last Iron Man finish was in September, 2019.

*"This was my fourth IM finish since surgery, bringing me to 7 finishes. I have also done several half iron races, half marathons, two double century rides and enjoyed several ski trips back to my Mecca of Jackson Hole. At risk of sounding trite, I thank Dr. Stone after every good run (skiing AND running). This ride I've been on is miraculous"*

Watch Emily's story





Combining posterolateral corner reconstruction with ACL revision surgery has saved many a loose knee. MCL or LCL ligaments are less frequently in need of repair or reconstruction; however, the techniques for doing so have improved dramatically over the last few years.

## Is a BioKnee right for me?

We will be able to assess your personal treatment options by taking a detailed history of your injury and symptoms, examining you carefully, and analyzing your recent (within 1 year) MRIs and x-rays. However, it may be helpful for you to know what comes into play when deciding whether a biologic or bionic solution is right for you. Here's what we consider:

### 1 Your injury history

Damage to the articular cartilage (the soft surface protecting the ends of your bones) or acute tears of either the ligaments (which connect the bones) or the meniscus (the knee's shock absorber) often occurs when the knee is suddenly twisted, the person hears a "pop" and the knee swells.

These acute injuries can most commonly be repaired or the tissue can be replaced. The patient can then return to full activities after appropriate rehabilitation is complete. We have learned that the success rates of primary repair increase when the injury is treated promptly.

If your knee injury occurred years or even decades ago, and you have lived with the pain, or have had multiple previous surgical interventions attempting to repair or resect the damaged tissues of the joint, you may need a more complex BioKnee procedure such as articular cartilage paste grafting combined with a meniscus allograft replacement or ligament reconstruction.

### 2 Your current symptoms

A common scenario for our patients is that they injured their knee playing high school or college sports, had some tissues taken out or a ligament reconstructed, and then over the years developed progressive knee pain.



**Jen Hudak,**  
Professional Skier

**Treatment:** *BioKnee - ACL replacements, articular cartilage, paste graft, posterolateral corner repair, meniscus repair*

In 2009, professional freestyle skier, Jen Hudak, suffered a devastating left knee injury that threatened to cut short her athletic career. Dr. Stone used an articular cartilage stem cell paste graft to repair her articular cartilage and rebuilt the back corner of her knee with a posterolateral corner reconstruction. Within six months she was back on the slopes winning X-Games Gold in the superpipe and every major national and international competition the subsequent year.

In a new injury in 2012, Jen ruptured her right knee ACL, tore the posterolateral corner of the knee, the medial meniscus, and damaged the articular cartilage on the end of the lateral femoral condyle. Each of these was repaired by Dr. Stone using the BioKnee techniques of donor ligament reconstruction, paste grafting, meniscus repair, and posterolateral corner reconstruction.

In 2013 Jen then re-injured her left knee's ACL. Dr. Stone reconstructed those ligaments with sterilized bone-patellar-bone grafts from a donor, repaired a new articular cartilage injury with a paste graft, and performed a complex meniscus reconstruction successfully returning Jen to full competitive form the following seasons so well that she competed successfully in 2018 taking third place in The Amazing Race. She bikes, hikes, and skis like a professional athlete to this day.

Watch Jen's story



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Their symptoms are often intermittent pain, swelling, giving way or buckling, achiness after walking, and sometimes limitation of knee range of motion.

X-rays and MRI's are particularly helpful to determine whether or not the damage inside the knee is in one portion of the knee or extensive throughout the knee. BioKnee procedures such as cartilage replacements can often be performed as long as there is space available, meaning that the joint is not completely bone-on-bone.

Patients who are candidates for a BioKnee often have symptoms associated with pain isolated primarily to one side of the joint and do not have underlying inflammatory arthritis such as rheumatoid arthritis which differs from injury-caused post-traumatic or osteoarthritis. Ideally, their range of motion is not too severely limited and their legs are not too badly bowed inside or curved outside (i.e. less than 10 degrees of angulation).

### 3 Your goals

Your goals play a vital role in determining which procedures should be performed. Ideal candidates for biologic repair and replacement of acutely injured tissues are people who would like to get back to sports and who can take the time to do the appropriate rehabilitation. We find that people whose goals are to stay active into their old age are motivated to prevent future osteoarthritis by stabilizing the knee and repairing the injured tissues.

In particular, for athletes who wish to continue impact sports, run hundred-kilometer races, or even run every day of the week, we recommend that they delay an artificial knee replacement by opting for biologic repair to keep the knee moving naturally.

We push the limits for biologic replacements in order to help delay the time in which an artificial component is placed for our high-impact athletes. With that said, many patients can perform at high levels of athletics with artificial components. However, our preference is to replace the biologic tissues whenever possible.



### Andrew H, World Champion Sailor

**Treatment:** *Patellar tendon repair*

Andrew is a world-class sailor, Melges 32 world champion, and match racing champion who developed severe elbow pain (lateral epicondylitis) from sailing in 2016 and chronic patellar tendon pain in 2018 from squatting and hiking out in his sailboat and from training hard on his mountain bike.

In the elbow, he responded brilliantly to injections of amniotic fluid with high levels of growth factors combined with direct soft-tissue massage physical therapy at The Stone Clinic.

For the patella tendon, he required a percutaneous debridement followed by injections of growth factors to recruit stem-derived cells to the site of his injury. He has returned to his previous level of racing glory and checks in for fitness training when he is sailing in San Francisco.

*“After Knee Surgery and Elbow Stem Cell injections, I was wondering if my athletic life was coming to an end! With all the rehab and PT lessons on how to get fit and strong again, I have been able to win the Laser masters USA National Championships, North American Championships, Pacific Coast Championships and come 4th in the World Championships.*

*All the best Andrew”*

Watch Andrew's story







## 4 Your approach to recovery

The accuracy of the surgical procedure is extremely important to a successful outcome, but equally important, is your personal commitment to the rehabilitation program. Most patients who have had arthritic knees or loss of cartilage over the years have favored their knee, have decreased range of motion, and have developed weakness in their quadriceps, core, and gluteal muscles due to an abnormal gait pattern that occurs from trying to avoid the pain. A successful replacement of cartilage is only as good as the ability to rehabilitate the entire body so that we normalize gait patterns and muscle strength returns. Without this, abnormal forces will continue to wear on the cartilage replacement and the life span of the cartilage replacement will be diminished.

We ask our patients to dedicate at least one hour a day to their physical therapy and rehabilitation programs until they have regained full motion and strength. We also encourage them to spend at least one hour a day focusing on a safe strength training and fitness program for the rest of their life. Our goal is to help you play sports until the end of your lifespan. Most often patients stay at our clinic at least one week after their surgery; some stay as long as two to three months working with our physical therapy team everyday (often for two hours a day for both rehabilitation and fitness training). Our goal is to return you to sports fitter, faster, and stronger than you have been in years.

## 5 Your attitude to treatment

We cannot make a promise or guarantee your outcome but we can tell you that the majority of patients do extremely well. Those that have a complication, problem, or failure have been returned to a successful outcome after the failure has been treated. We have learned that the happiness and motivation of the patient who enters into the clinic environment and into the operating room affect the whole team and the outcome. We encourage you to bring your positive attitude and watch how it influences your outcome.

The beauty of biologic joint reconstruction procedures is that should one of the procedures fail or tear earlier than expected, in most cases, it can be fixed, repaired, or replaced as needed. The attitude of the patient plays a large role in the speed of their recovery. Patients who keep their head in a good place and have a good spirit about it, tend to do the best.



### Natalya V., Ballet Dancer

**Treatment:** *ACL reconstruction  
(BTB allograft)*

Ballet dancer patient, Natalya tore her ACL during a rehearsal. She did not want to use her hamstring to repair her ACL. She came to The Stone Clinic where Dr. Stone reconstructed the injury using donor bone-patellar tendon-bone tissue.

Dancers cannot afford to lose a portion of their patella tendon or their hamstrings. So, when the ACL is completely ruptured, Dr. Stone reconstructs it with a donor bone-patellar tendon-bone graft, often pre-loaded with the patient's own growth factors stem cells. During surgery, the graft is placed so as to permit the knee to extend equally to the opposite knee—which, for many dancers, actually means hyperextension. Traditional graft placements often did not allow this extra motion. Without it, though, the dancer would never be the same.

With this type of repair, Natalya was able to return to professional performance level and now dances five times a week, teaching other dancers as an instructor: "I am awesome, back to 100%, performing better by focusing on form."



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Watch Natalya's story >

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## If a BioKnee is not right for me, what are my other options?

For patients who are not candidates for a biologic knee replacement, because the degeneration has progressed to the point of being bone-on-bone, we have a number of options projected to increase to three million by 2030.

### Partial knee replacement

If the cartilage damage is extensive but limited to just one or two parts of the knee, we have had tremendous success resurfacing only the worn-out portion of the joint (either the inside, outside or kneecap) leaving the rest of the joint alone.

For unparalleled accuracy in placement, we use the MAKO Surgical Robotic Arm Interactive Orthopaedic System. The MAKO robot is the most accurate and sophisticated joint replacement system in the world. The system robotically guides the surgeon to precisely replace the joint, resulting in better alignment and reducing the risk of early wear.

This is an outpatient procedure, after which the patients can weight-bear on the implant immediately, leading to a remarkably rapid recovery. The majority of patients who are referred to us for a total knee replacement find that only one part of the joint is worn out. More than 80% of these patients have been candidates for a partial knee replacement rather than a total knee replacement.

### Total knee replacement

Sometimes a total knee replacement is the best option. When multiple parts of the joint are worn out and a total knee replacement is indicated, we have found that by using the MAKO Surgical Robotic Arm we have been able to avoid the use of bone cement, securing the implant to your knee joint with a perfectly placed, uncemented bony ingrowth implant. The absence of cement gives us and our patients confidence that when they return to full sports they are unlikely to loosen the implant.



**Scott Endsley,  
Triathlete age 62**

*Treatment: MAKO Robotic-assisted Partial  
Knee Replacement*

Scott is a world-class triathlete who presented to us in 2014 after having nine right knee surgeries beginning in 1974. He had an arthritic knee with a poor range of motion and stiffness, however, not much pain. His left knee had articular cartilage loss, meniscus tears, loss of motion, and pain.

Scott underwent a partial knee replacement for his left knee. He then completed the Wildflower Triathlon two months after his partial knee replacement, as well as a second triathlon the day after.

Five months post-surgery, he completed the San Francisco triathlon where he came in second place. Nine months later, he reported his knee was “perfect” and he qualified for the World Championships in multisports in Canada. In 2018, he reported no issues with his knee.

[Watch Scott's story](#)





Many of our patients a return to skiing, climbing, and hiking on their joint replacements. Exercising daily makes stronger bones and muscles and simultaneously diminishes the most common causes of failure of joint replacement, which is weakening of the bone leading to loosening of components.

In thirty years of partial and total knee replacements, we have only seen one perfectly placed component wear out from activities. The treatment was the replacement of the plastic insert. Accuracy of placement is the key to reducing wear over time and computer-assisted robotic surgery has increased the accuracy of placement in our hands.

## Conclusion

To keep you active playing sports and enjoying the activities you love until you are 100 years old we need to keep your joints moving. Using biologic and selected bionic replacement solutions combined with dedicated rehabilitation and fitness programs is the way forward.

If you can see yourself as an athlete in training and not a patient in rehab we can achieve the goal to return you to a fitter, faster, stronger version of you.



**Connect with Dr. Stone to find out more about your treatment options**

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