

## Patients in the News:

### Bill Schneiderman: Health-Care Savvy and on the Mend

Editor's Note: The following profile is based on an interview by Dick Needham. Mr. Needham is editor of the skier newsletter "Inside Tracks" and senior contributing editor of *Ski Magazine*.

To say "It takes one to know one" is an overused cliché. But in Bill Schneiderman's case, the expression is apt. Schneiderman, today a real estate executive with Marriott International, had for 20 years enjoyed a career in health care, where his work focused on the development of health-care-delivery systems. He served as chief executive of the Metropolitan Boston Emergency Medical Services Council, a consultant to the National Heart, Lung, and Blood Institute of the National Institutes of Health, a member of the Harvard Injury Control Center, and a lecturer at the Harvard School of Public Health. Schneiderman also served as a consumer member of Harvard Community Health Plan's Member Appeals Committee, and later became chairman of the committee. He was, and is, by his own admission, "a very savvy health-care consumer—and consumer advocate." As a longtime professional ski patroller at Vermont's Stratton Mountain, Bill also was, and is, an avid skier—and that's where his story begins.

He was packing for a ski trip to Vail two years ago. After lifting his suitcase, he felt a sudden, strange sensation in his knee. One week later, after seven days of hard skiing, while getting up from a table in a local Vail pub, his knee gave out.

"Who knows what caused it," says Schniederman. "My surgeon suggested it was the result of degenerative wear. A friend—a head and neck surgeon—said my knee warrantee simply ran out."

The diagnosis: a medial collateral ligament strain, for which he was put in a brace and referred to a physical therapist for rehab. Schneiderman's then orthopaedic surgeon ordered an MRI evaluation of his knee, which revealed a torn medial meniscus. He subsequently had two arthroscopic surgeries—one in May 2000, another in September of the same year—

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## SPORTS AND WELLNESS:

### Tips from NFL's Broncos Can Keep You Healthy on the Slopes.

By Jeff Carlson

Editor's Note: Mr. Carlson is a physical therapist for the Howard Head Sports Medicine Center in Vail, Colo.

Recently I had the opportunity to work with the Denver Broncos during their training camp in Greeley, Colo. For players and personnel alike, training camp was not exactly perceived as a "good time." For people on the training room staff, equipment room staff, video productions, media, coaching, etc., it consisted of 12-to-15 hour days seven days a week. For the players, it was two grueling practices a day and three to five hours of meetings lasting as late as 11 p.m. However, it was a wonderful experience being able to work with the athletes and help

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## Steadman♦Hawkins Research Update:

### Gene Therapy as a Potential Means of Healing the Injured Joint

By Dr. Wayne McIlwraith

Editor's Note: Dr. McIlwraith is a world-renowned equine surgeon and is director of Equine Sciences at Colorado State University's veterinary school. He is a member of the Steadman♦Hawkins Sports Medicine Foundation's Scientific Advisory Committee.

In the spring newsletter, Dr. Rodrigo outlined very thoroughly the concept of cytokine growth factors and their potential for tissue repair and regeneration. In that article, Dr. Rodrigo discussed how cytokine growth factors are considered "signaling" proteins because they tell the cells what to do and how certain of these proteins may either stimulate the breakdown of the cartilage matrix (such as interleukin-1) or promote synthesis (such as insulin-like growth factor 1). Work has been done with the addition of

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PHOTO COURTESY OF JOHN KELLY.

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Measuring Shoulder Motion:  
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## Albert Hartnagle: One Step Ahead of a Smoke Signal

For more than 30 years, Albert Hartnagle lived a life that was hard on his body. As a cattle rancher, horse-trader, alfalfa farmer, and breeder and shower of champion sheep, the demanding years of physical labor left his knees virtually crippled with arthritis.

Enter Steadman♦Hawkins Sports Medicine Foundation and a team of surgeons that performed a “world of good” in restoring his mobility. But it wasn’t just the medical success that impressed him. He was also impressed with the bedside manner of the doctors. “They actually treat you like a human,” he says.

As a result of his care, Hartnagle made a significant gesture—a bequest that leaves his entire estate to the Steadman♦Hawkins Sports Medicine Foundation. “I worked hard all my life and I want my life earnings to help others,” he says.

But he didn’t just want to help others, he wanted to help as many people as possible. He communicated this to his attorney—how he felt about helping others and why, in particular, he wanted to allow the Foundation to do “whatever they need to do” with his bequest. Hartnagle believes the Foundation will know where his bequest can do the most good when it’s received. And, not knowing when that will be, he created an unrestricted bequest.

For now, however, Hartnagle is glad to know he still has control of his assets for whatever needs might arise during his lifetime. And what might Albert Hartnagle be spending those assets on during his lifetime? It well might be on enjoying gourmet cuisine, one of his favorite pastimes. But it probably won’t be on a computer. Asked if he would like to receive an e-mail copy of this article, he replied, “Oh no, I don’t have any of that stuff. Me, I’m just one step ahead of a smoke signal.” That may be true in terms of technology, but in terms of compassion Albert Hartnagle’s smoke signal says he cares.

For more information on how you can make a bequest to the Foundation, call John McMurtry at 1-970-479-5781. ■

## Functional Knee Brace Can Reduce Further Risk for ACL-Injured Skiers

For snow skiers, both amateur and professional, knee injuries are a fact of life. However, a study by the Steadman♦Hawkins Sports Medicine Foundation shows that skiers with knee instability caused by a weakened anterior cruciate ligament (ACL)—the rubber-band-like ligament that helps keep the thigh and shin bones aligned—can significantly reduce their risk of subsequent knee sprains or tears by wearing a functional knee brace. The foundation presented these findings at the 68th annual meeting of the American Academy of Orthopedic Surgeons (AAOS) in San Francisco, which took place February 28 - March 4, 2001.

“This is an important study because it’s the first one to look at the effectiveness of knee bracing in a clinical, as opposed to



PHOTO: INNOVATION SPORTS

biomechanical, setting,” said Mininder Kocher, M.D., M.P.H, one of the study’s co-authors, a former Fellow and a member of the Foundation’s Scientific Advisory Committee. “As part of our ski injury prevention program guidelines, we now recommend that people who have previously injured their anterior cruciate ligament, and spend a considerable amount of time skiing, consider wearing a knee brace when participating in the sport.”

### ACL’s Role in Knee Injuries

The anterior cruciate ligament prevents the knee from straightening beyond its normal limits. Because the ACL is relatively weak, skiers often tear them when they put undue stress on their knees—for instance, during jumps, twists and landings—or when their bindings fail to release during a fall. In these situations, the ligament stretches, tears, or breaks apart, resulting in painful knee injury.

The American Academy of Orthopedic Surgeons estimates that approximately 80,000 ACL tears occur annually in the United States, with approximately 24,000 affecting individuals involved in sports that involve pivoting, such as skiing.

### Non-Braced Skiers More Likely to Suffer Injuries

The study findings presented at the AAOS medical meeting were part of a major research effort on ski injuries conducted by the Steadman♦Hawkins Sports Medicine Foundation during the past decade. The Foundation is now using the results of its research to develop effective injury prevention programs for skiers.

At the start of the main study, researchers screened for injuries 9,410 professional skiers who worked at Vail Resorts, one of the leading resort operators in North America and a sponsor of the Foundation. As a subset of this research, the Foundation identified a group of 159 skiers who had previously suffered ACL knee damage, then identified certain risk factors thought to cause successive knee injuries (i.e., gender, age, and whether the skiers wore knee braces) and charted their subsequent injuries via workers’ compensation claims from 1992 to 1997.

During this five-year period, 71 men and women in the study group did not wear braces, while 88 did. This latter group self-selected and wore the CTI2 knee brace from Innovation Sports, a sponsor of the Steadman♦Hawkins Sports Medicine Foundation, which makes cus-

tom and ready-to-fit knee braces. According to Dr. Kocher, "The most significant result we obtained from the study was that non-braced skiers were six times more likely to sustain a subsequent knee injury than braced skiers — 9.9 percent vs. 2.3 percent." ■

## Silliman Named Foundation CEO



James Silliman, M.D.

Former Steadman-Hawkins Fellow Dr. James Silliman has been named CEO and President of the Steadman♦Hawkins Sports Medicine Foundation. His appointment follows the resignation of Charles J. Dillman, Ph.D., who after two successful stints as head of the Foundation is leaving to pursue other business interests. "Dr. Dillman raised the Steadman♦Hawkins Sports Medicine Foundation to the premier private research foundation in the country," said Dr. Silliman.

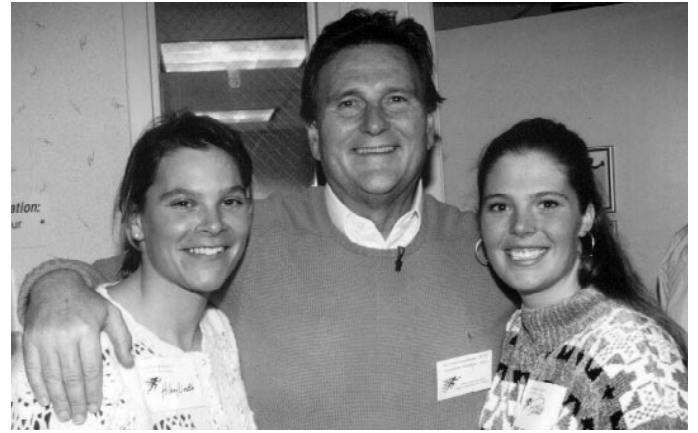
Dr. Silliman brings a broad medical management and academic background to the Foundation, having trained as an orthopaedic surgeon in Dr. Steadman's fellowship program in Lake Tahoe in 1987 and in Dr. Hawkins' shoulder fellowship program in Vail in 1991. Dr. Silliman received his medical degree from the University of Louisville in 1982, graduating summa cum laude. He completed a General Surgery internship in 1983 and an Orthopaedic residency in 1987 at the University of Texas Southwestern Medical School in Dallas. After completing his Fellowship with Dr. Steadman, Dr. Silliman entered private practice with Fort Wayne Orthopedics in Fort Wayne, Ind., where he served from 1987 through 1990. He served as a team physician for the U.S. Ski Team from 1987 to 1991.

From 1991 through 1994, Dr. Silliman was Assistant Professor and Program Director at the Department of Orthopaedic Surgery at the University of Texas Southwestern Medical Center and the Head of Shoulder Services at Parkland Memorial Hospital in Dallas.

Following a decade of clinical practice, Dr. Silliman served as the Chairman and Medical Director for CareSelect Group, Inc., a company which he founded, and as managing director of nine independent physician associations in Texas. His company grew to be the largest manager of special capitation in the Southwest and the second largest manager of cardiovascular practices in the nation. From 1999 to the present, Dr. Silliman has been a partner in EMed Ventures, an early-stage venture capital firm focusing on emerging technologies in the health-care field. He presently serves on the board of three of these companies.

During his training and practice, Dr. Silliman served in a development and advisory capacity to several orthopaedic-device manufacturers, serving on corporate and advisory boards. He was involved in projects that went from the development stage, through FDA approval, to marketing and sales. He designed and developed orthopaedic devices that were later commercialized. ■

## Dr. Steadman Inducted into Colorado Ski Hall of Fame 25th Annual Ski Hall of Fame Honors Foundation Founder for Contributions to Sport



Dr. Steadman with patients Hilary Lindh (left), World Champion in Downhill, and Olympic Champion Picabo Street.

The Colorado Ski Hall of Fame inducted Dr. J. Richard Steadman, along with four other new members, on October 19. The Ski Hall of Fame honors those who have contributed extensively to the sport of skiing in Colorado. Dr. Steadman, a Texas native, founded the world-renowned Steadman-Hawkins Clinic in Vail in 1990 with Dr. Richard J. Hawkins. He became chairman of the U.S. Ski Team medical group in 1976, as chief physician, and continues in that role today. In this capacity, he organized the U.S. Ski Team's Sports Medicine Council and recruited a group of world-renowned authorities in sport science to help U.S. Ski Team athletes perform at a higher level and reduce the incidence of injuries.

Dr. Steadman established the Steadman♦Hawkins Sports Medicine Foundation to develop innovative methodology to treat, care for, and prevent ski injuries in all levels of skiers. Through the Foundation's research, he has pioneered new surgical techniques — microfracture and healing response — to restore ski injuries and to preserve function in all active people. His surgical skills and postoperative rehabilitation programs not only benefited the U.S. Ski Team, but many thousands of active people with serious injuries, including members of other professional sport teams.

He has saved the careers of Olympic and World Championship skiers Debbie Armstrong, Christin Cooper, Marc Girardelli, Bill Johnson, Greg Jones, Hilary Lindh, Phil Mahre, Steve Mahre, Tamara McKinney, Tommy Moe, Cindy Nelson, Pete Patterson, Diann Roffe-Steinrotter, Picabo Street and Pernilla Wiberg. All of these athletes, with the exception of Tamara McKinney, were treated by Dr. Steadman for serious injuries prior to winning their Olympic or World Championship medals. Others who have been under Dr. Steadman's treatment are John Elway, Joe Montana, Dan Marino, Terrell Davis, and tennis stars Martina Navratilova and Monica Seles. In 1989 Dr.

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Steadman was inducted into the U.S. National Ski Hall of Fame in Ishpeming, Mich., and is the recipient of the 12th Annual AT&T Skiing Award, a lifetime achievement award for commitment to excellence and dedication to skiing.

Other Hall of Fame inductees honored with Dr. Steadman were Earl Clark, Tenth Mountain Division pioneer, ski mountaineer and patrolman, who spent a lifetime dedicated to the sport of skiing; former President Gerald R. Ford, known as the first skiing president and who was instrumental in bringing two World Alpine Ski Championships to the state of Colorado; Dave Jacobs, founder of Spyder Active Sports, Inc., a ski apparel manufacturer and supplier to the U.S. Olympic Ski Teams; and Franci Peterson, a Colorado native, who dedicated her life to teaching skiing.

## Smith & Nephew Endoscopy New Foundation Sponsor

Smith & Nephew Endoscopy recently joined the growing list of Steadman♦Hawkins Sports Medicine Foundation supporters with a five-year unrestricted educational grant for orthopaedic and arthroscopy research. As part of this partnership, Smith & Nephew will also provide state-of-the-art endoscopic devices for use in the Steadman-Hawkins BioSkills Lab.

The Steadman♦Hawkins Sports Medicine Foundation is a leader in research into causes and treatment of osteoarthritis and degenerative joint disease — its treatment and cure — as well as the treatment and rehabilitation of other sports injuries. Dr. Steadman is known for his development and refinement of the microfracture technique in orthopaedic surgery. For many years, Dr. Steadman has been chief physician to the U.S. Ski Team and Dr. Hawkins has been chief physician to the two-time Super Bowl Championship Denver Broncos football team and the Colorado Rockies baseball club.

“New medical knowledge and technologies and compelling partnerships with physicians have helped solidify Smith & Nephew’s pioneering position in the endoscopic marketplace,” says Ron Sparks, Smith & Nephew president. “Our relationship with the Steadman♦Hawkins Sports Medicine Foundation was designed to support our goal of defining and meeting the future medical needs of both physicians and patients.”

Foundation CEO James Silliman, M.D., commented, “Not only do we appreciate the support of Smith & Nephew, the sponsorship exposes us to the innovation and leadership they have demonstrated in endoscopic surgery.” Smith & Nephew Endoscopy ([www.endoscopy1.com](http://www.endoscopy1.com)) is a world leader in the development and commercialization of endoscopic techniques. Within endoscopy, Smith & Nephew is the recognized world leader in arthroscopy. Smith & Nephew Endoscopy is one of the core businesses of Smith & Nephew plc, (NYSE: SNN), a leading worldwide medical devices company with a highly successful track record in developing, manufacturing, and marketing a wide variety of innovative and technologically advanced tissue-repair products. Their products are used primarily in the areas of bones, joints, skin and other soft tissue. The company has established sales in more than 90 countries. For further information, visit Smith & Nephew’s website at [www.smith-nephew.com](http://www.smith-nephew.com). ■

## Steadman♦Hawkins Update: Publications, Presentations, and Research

The American Academy of Orthopaedic Surgeons (AAOS) annual meeting will be held in Dallas Feb. 13-17. The Foundation has produced several publications and presentations that will be accepted at this meeting.

Karen Briggs, M.B.A., director of Clinical Research, reports that the following two-poster presentations have been accepted: *A Minimally Invasive Technique (“Healing Response”) to Treat Acute ACL Injuries in Patients 40 Years and Older*, by J. Richard Steadman, M.D.; Michelle Cameron, M.D.; Karen Briggs, M.B.A.; and William G. Rodkey, D.V.M. The second poster is *Lysis of Pretibial Patellar Tendon Adhesions (Interval Release) Determinants of Patient Satisfaction After ACL Reconstruction* by Sumant G. Krishnan, M.D.; J. Richard Steadman, M.D.; Peter J. Millett, M.D.; Kimberly Hydeman, B.A.; Matthew Close, B.A.; Mininder S. Kocher, M.D., M.P.H.; D. Zurakowski, M.D.; Karen Briggs, M.B.A.; William I. Sterett, M.D.; and Richard J. Hawkins, M.D.

Presentations accepted include: *Prevalence of Osteoarthritis in Patients with Shoulder Instability*, by Michelle Cameron, M.D.; Karen Briggs, M.B.A.; Mininder S. Kocher, M.D., M.P.H.; Marilee Horan; and Richard J. Hawkins, M.D. (This paper will also be presented to the American Orthopaedic Society for Sports Medicine.) *Relationship of Instrumented Knee Laxity, Lachman Examination, and Pivot-shift Examination to Subjective Symptoms and Function After ACL Reconstruction*, by Mininder S. Kocher, M.D., M.P.H.; J. Richard Steadman, M.D.; D. Zurakowski, M.D.; Karen K. Briggs, M.B.A.; William I. Sterett, M.D.; and Richard J. Hawkins, M.D.; and *Management and Complications of ACL Injuries in Skeletally Immature Patients: A Survey of the Herodicus Society and the ACL Study Group*, by Mininder S. Kocher, M.D., M.P.H.; Hillary S. Saxon; W. David Hovis, M.D.; and Richard J. Hawkins, M.D.

Michael Torry, Ph.D., director of the Biomechanics Research Laboratory, reports that the research paper *A Dynamic Model of the Knee and Lower Limb for Simulating Rising Movements*, by Kevin Shelburne, Ph.D. (see page 11), and Marcus G. Pandey, Ph.D., has been accepted for publication in “Computer Methods in Biomechanics and Biomedical Engineering,” May 24, 2001, issue. The calculations in the study support the contention that squatting is “a relatively safe exercise for rehabilitation following ACL reconstruction.”

## Awards

Congratulations to Staff Scientist **Mike Decker** of the Biomechanics Research Laboratory. At the XVIIIth Congress of the International Society of Biomechanics, held this past July in Zurich, Mike won the prestigious **Scherb Award** for his paper *Mechanisms of Compensating for ACL Deficiency During Gait*. Authors included **Michael R. Torry, Ph.D.; Michael J. Decker, M.S.; Henry B. Ellis;** and **J. Richard Steadman, M.D.** This research is important because it has been reported that a number of individuals with anterior cruciate ligament (ACL) ruptures are able to return to high levels of activity without surgical reconstruction. The study examines how these individuals are able to compensate without an ACL. Results indicate that the hamstring and hip extensor muscles play an important role in “active” individuals who are ACL-deficient. The Scherb Award recognizes outstanding

biomechanical research in the area of human locomotion with emphasis on clinical application. Also, the paper "Gait Re-Training ACL-Reconstructed Individuals," by **Michael J. Decker, M.S.; Michael R. Torry, Ph.D.; T.J. Noonan, M.D.;** and **J. Richard Steadman, M.D.** was a finalist for the **Clinical Biomechanics Award**.

Congratulations are also in order for the Biomechanics Research Lab staff, **Dr. Hawkins** and former Fellow **John M. Tokish, M.D.** Their research paper, *The Belly-Press Test for the Physical Examination of the Subscapularis Muscle: Description Electromyographic Validation and Comparison to the Lift-off Test*, is one of four finalists for the **Charles S. Neer Award**. More than 300 abstracts were submitted and eight were selected to submit full manuscripts. The award will be presented at the Eighteenth Open Meeting of the American Shoulder and Elbow Surgeons on February 16, 2002, in Dallas. The winning paper will be published in *The Journal of Shoulder and Elbow Surgery*. Authors are **John M. Tokish, M.D.; Michael J. Decker, M.S.; Henry B. Ellis; Michael R. Torry, Ph.D.;** and **Richard J. Hawkins, M.D.**

## Board of Directors in the News

Congratulations to Foundation Board member **Howard P. Berkowitz**, who was presented this past year with the **Americanism Award** from the **Anti-Defamation League**. He had just completed an outstanding three-year term as National Chair of the ADL and was honored with a special tribute evening in April in New York City. "The Americanism Award," read the citation, "was established to honor those exceptional individuals and institutions that illuminate and exemplify the noblest ideals and traditions of the United States and of the Anti-Defamation League."

During his term as National Chair, he conferred with elected officials and leaders in Washington, D.C., Israel, Russia, Saudi Arabia, Germany, Italy, France, Bulgaria, Argentina, Chile, Uruguay, Turkey, Latvia, Lithuania, Austria, Belarus, Switzerland, Egypt, Jordan, and the Vatican. Howard Berkowitz is founder and managing partner of the Manhattan investment-management firm, HPB Associates, L.P. Mr. Berkowitz serves on the undergraduate Board of the Wharton School and has been active in the ADL for 22 years. He now serves as National President of the ADL Foundation. He is a member of the Steadman-Hawkins Sports Medicine Foundation's Executive Committee and chairs the Finance Committee.

And congratulations to Board Member **Greg Norman**, who was inducted into the **World Golf Hall of Fame** in November. Norman, a two-time British Open Champion, has won 75 tournaments worldwide, including 18 PGA victories.

## In Memoriam

Steve Barton, one of the world's most highly acclaimed actors and dancers, Steadman-Hawkins patient alum and performer/participant at the 2000 Steadman-Hawkins All-Star Ski Celebration, died on July 21 in Bremen, Germany, where he had gone to make a recording. He was 47.

Barton's career spanned 10,000 live performances in more than 70 productions in seven countries. A multi-talented performer, he performed in Europe, London's West End, Los Angeles, and on Broadway. He sang for several Presidents, the Royal Family and, as he always said, "the occasional children's birthday party." He



Steve Barton in  
*Phantom of the Opera*

was an important proponent of the work of the Steadman-Hawkins Sports Medicine Foundation. "What impresses me about the Foundation's work," Barton said a year ago, "is the commitment to the exploration of new modalities and the determination to find the things that work. It's one thing to be theoretical and quite another to actually get out there and do it. And that's what the Foundation's research team has done — they've turned up solutions that are practical.

"Especially as a professional, in whatever sport or activity you're involved in, you have to know that the amount of time you invest in something is going to give you a return. That's what I most appreciate — the practicality of the Foundation's research, a 'this works' approach that can be seen in the way surgery is performed and the way post-op therapy is approached." Barton was the honorary chair of the Foundation's Fall 2000 annual fund drive and will be remembered for his performances during the Steadman-Hawkins All-Star Ski Celebration.

## Where Are They Now?

The graduating class of 2000/2001 Steadman-Hawkins Fellows are off serving their country or busy establishing new orthopaedic practices. **Michelle Cameron, M.D.**, is working at Rocky Mountain Orthopedic Specialists in Cheyenne, Wyo., and is team physician for the University of Wyoming, USA Rugby, and a Wyoming Minor League baseball team. **Mark Curzan, M.D.**, now works for Cary Orthopaedic and Sports Medicine Specialists in Cary, N.C. **David Gazzaniga, M.D.**, works for Pro Health in Lake Success, N.Y. He is a team physician for the New York Islanders hockey club. **Sumant Krishnan, M.D.**, works for W.B. Carrell Memorial Clinic in Dallas and is team physician for the Dallas Cowboys, Dallas Stars, and Southern Methodist University Mustangs athletic programs. **Peter Millett, M.D.**, is a physician at Brigham and Women's Hospital, Department of Orthopaedics. And our thoughts and prayers are with **Maj. John M. Tokish, M.D.**, a surgeon for the U. S. Air Force Academy Hospital and sports medicine program who was deployed to the Middle East in October to command an orthopaedic unit. Prior to his departure, he served as team physician for all Academy Division I sports, as well as local prep school teams.

A special "thank you" to our many donors who make the Fellowship program possible; it is considered one of the top orthopaedic sports medicine fellowship programs in the world. We'd like to recognize those individuals and foundations that support the entire Fellowship class through the sponsorship of Academic Chairs. Chair sponsors of the 2000/2001 Steadman-Hawkins Fellowship Class are **The Fred and Elli Iselin Foundation, Mr. and Mrs. Lawrence Flinn, Mr. and Mrs. Jay Jordan, Mr. and Mrs. Henry Kravis, Mr. Ron Miller, and Mr. and Mrs. Steven Read.**

Fellowship Benefactors fund the research of one Fellow for one year. Each benefactor is assigned a Fellow, who provides written reports and updates of his work. We extend our gratitude to the following individuals for their generous support: **Mr. and Mrs. Jay Precourt, Mr. and Mrs. William Esrey, Mr. Lyndall Boal, Mr. Tim McAdam, Mr. and Mrs. Kent Logan, Mr. Milledge Hart, Mr. and Mrs. John W. Jordan, Mr. and Mrs. S. Robert Levine, Mr. Tom Quinn, and Mr. and Mrs. Stewart Turley.**

## MEDIA

In October, the **Discovery Health Channel's 21<sup>st</sup> Century Medicine** aired a special program—“Athletes Back in the Game”—featuring Foundation research. **Dr. Steadman** and the Foundation's Biomechanics Research Lab were center stage in the segment, which was taped in Vail, Colo., last spring. The show focused on microfracture and the Biomechanics Research Lab's virtual knee project. According to producer Bob Langford, “The show is about leading-edge advances in sports medicine, and the Foundation's research is where it's happening.” The show, presented three times in the U.S., will air in 17 countries, be translated into 26 languages, and be viewed by a total audience of approximately 140 million. **Michael R. Torry, Ph.D.**, was also interviewed October 17 by Dr. Bob Arnot on **MSNBC** as part of a panel discussion on osteoarthritis. Dr. Torry was questioned about movement mechanics, exercise that can contribute to osteoarthritis, conservative treatments, physical therapy, and how strength and aging affect osteoarthritis.

The Sunday, November 4, *Denver Post* Sports and the Sunday, November 11, *Denver Post* Sports reported on the progress of U.S. alpine skier and Winter Olympic medal hopeful **Bode Miller**. At the World Alpine Championships last February in St. Anton, Miller crashed and tore the ACL in his left knee.

The severe knee injury was a blow that seemingly put Miller's hopes for the 2002 Olympics in severe jeopardy. The November 4 *Post* article reported: “But Dr. Richard Steadman of Vail, one of the world's leading orthopedic surgeons, performed a procedure that sometimes induces the anterior cruciate ligament to heal on its own (healing response) without surgical repair. It did, making a full reconstruction unnecessary. That shortened Miller's rehabilitation time by about three months and made it possible for him to start the season at full strength.”

Remarkably, eight months later in October, the World Cup season opened in Soelden, Austria, and Miller scored a fifth in giant slalom. Stay tuned for the Winter Olympics in February 2002 and Bode Miller.

Seventeen-year veteran, future Hall-of-Famer and Washington Redskin **Bruce Smith** also saluted Dr. Steadman in the November 15 *Denver Post* during his team's visit to Denver to play the Broncos. He believes his career would have been over long ago were it not for the efforts of Dr. Steadman, who has operated on Smith's knees five times. Following microfracture on both knees, Smith went on to become **NFL Defensive Player of the Year** after the 1997 season. “I think my career would have been over about five years ago, I really do,” said Smith. “He has not only been a person that has helped me medically, but he's been a good friend as well.” Source: Adam Shefter, *The Denver Post*. ■

## Female Athlete Triad: Prevention Is Key to Treatment

By Michelle Cameron, M.D.

Editor's Note: Dr. Cameron, who authored this article, completed her medical training in Vail in the Steadman-Hawkins Sports Medicine Foundation's Fellowship Program in 2001.

Over the last 20 years, women's sports have exploded. Female athletes have come a long way from the 1912 Olympics, where the press portrayed the 5000-meter distance runners as “fainting

and near death” when they crossed the finish line. Overall, the trend toward equal representation of female athletes in all sports has increased the fitness level of women in general. However, with this increased level of fitness has emerged a unique set of women's health issues. One that has resulted in the most concern is the “female athlete triad.”

This triad consists of eating disorders, menstrual dysfunction and premature osteoporosis. Unfortunately, it is a very common problem among high-level athletes. Several studies have documented the fact that approximately 30 percent of female college athletes experience at least some form of this triad. Those at highest risk are athletes involved in sports such as gymnastics, ice skating, and distance running, where body image is emphasized. The incidence of triad is as high as 60 percent in competitive distance runners and college gymnasts. Unfortunately, little has been done to address this pervasive problem.

The triad is usually initiated by an eating disorder coupled with excessive exercise. Once the body senses a critical calorie deficit, it shuts down the menstrual cycle. Menses is thought to shut down because the body knows that it cannot support a pregnancy in this starvation setting. Once menses is shut down, the body no longer produces estrogen to stimulate bone formation. The result is loss of existing bone and failure to replace that which is lost. In a very short time, the skeleton can become osteoporotic and susceptible to fracture, especially when subjected to continued excessive training.

This health issue is virtually ignored amongst elite athletes, coaches and trainers. The key to treatment is prevention. And the key to prevention is educating female athletes, families, coaches, trainers, nurses, primary care physicians and orthopaedic surgeons. The athletes themselves, as well as their families and coaches, need to understand the consequences of eating disorders and menstrual dysfunction to their long-term health. ■

## Education:

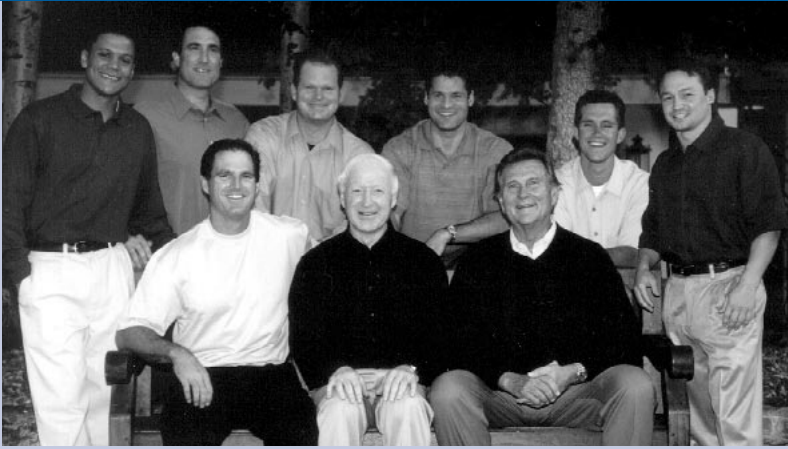
### WELCOME 2001-02 FELLOWS Six New Physicians Introduced

The leaves have turned and the mountain peaks are dusted with snow, signaling the beginning of a new and busy year for the incoming “class” of Steadman-Hawkins Fellows. Regarded as one of the most prominent academic Fellowship programs in orthopaedic sports medicine, six new orthopaedic surgeons are selected each year from a pool of more than 150 applicants.

Steadman-Hawkins Fellows spend their year refining skills and learning new techniques from Drs. Steadman, Hawkins, and Sterett. The Fellowship program includes an opportunity to participate in research with Foundation scientists. Each Fellow will be actively involved in Clinical, Basic Science and Rehabilitation/Human Performance research. The Fellows will also experience “hands-on” medical coverage of major league baseball's Colorado Rockies, the NFL's Denver Broncos and Eagle County High School sports teams.

The stream of knowledge and information flows both ways. The Fellows, having completed their formal training in leading orthopaedic programs, share knowledge they have gained from years of training with the physicians and scientists of the Foundation.

**Jason Folk, M.D.** – Dr. Folk graduated with an honors degree in biology from the University of Texas at Austin and then went on to the University of Texas-Southwestern for medical school and his residency. As a med-



Drs. William I. Sterett, Richard J. Hawkins, and J. Richard Steadman, with 2001/2002 Fellows, rear left to right: David C. Johnson, M.D.; Bruce S. Miller, M.D.; Richard L. Lawton, M.D.; Thomas, A. Joseph, M.D.; Jason, W. Folk, M.D.; and Douglas J. Wyland, M.D.

ical student, he was elected to the Alpha Omega Alpha Honor Society. Dr. Folk's interest in research is evidenced by his publications in the *Journal of Orthopaedic Trauma*, *Journal of Pediatric Orthopaedics*, and *Journal of Nuclear Medicine*, as well by the presentation of his fractures analysis at several prestigious orthopaedic conferences. Dr. Folk, a Colorado native and avid skier, will be joined by his wife Jennifer.

**David Johnson, M.D.** – Dr. Johnson spent his academic career at the University of Virginia as an undergraduate major in psychology and then as a medical student. In medical school, he conducted research in a motion analysis lab and was the recipient of a Medicine Leadership Award and Teaching Award, among a host of other honors. Dr. Johnson completed his residency at the Hospital for Special Surgery, where he continued his research efforts by analyzing distal biceps tendon ruptures in athletes and the lumbosacral spine of elite football linemen. He has been published in the *American Journal of Sports Medicine*, *Journal of Pediatric Orthopaedics*, and the textbook *The Athlete's Elbow*. Dr. Johnson, a college track athlete, will be joined by his wife Tracy.

**Thomas Joseph, M.D.** – Dr. Joseph graduated from John Carroll University with a degree in biology. He attended the Ohio State University College of Medicine, where he was awarded a grant by the National Cancer Institute/National Health Institute to fund a surgical oncology project that received high acclaim. As a resident at the Cleveland Clinic Foundation, Dr. Joseph developed a particular interest in the study of glenohumeral instability, a focus that he would like to continue exploring during his fellowship year. He has been published in such publications as *Orthopedics*, *Foot and Ankle International*, and *Techniques in Fracture Surgery*. Dr. Joseph will be joined by his wife Kristen and son Anthony.

**Richard Lawton, M.D.** – Dr. Lawton will spend the year in close proximity to his undergraduate alma mater, Colorado College, where he was captain of the varsity football squad and named most valuable offensive player. Prior to entering medical school, Dr. Lawton earned his doctoral degree in Industrial/Organizational Psychology at DePaul University, where he was named Shmitt Academic Scholar. He served as class president for three consecutive years at Emory University School of Medicine. As a resident at the Mayo Clinic in Rochester, Minn., Dr. Lawton received the Mark B. Coventry Clinical Research Award and has been published in various journals, including the *Journal of Bone and Joint Surgery* and *American Journal of Sports Medicine*. While in Rochester, he also has found time to become

involved with the local amateur and minor league baseball clubs. Dr. Lawton will be joined by his wife Susan and daughters Julia and Sarah.

**Bruce Miller, M.D.** – Dr. Miller completed the Harvard Combined Orthopaedic Residency Program after earning both his undergraduate and medical degrees at Harvard. An undergraduate student-athlete, he studied anthropology and was named Rhodes Scholarship finalist, as well as All-American and All-Ivy League in rugby. Prior to arriving in Vail, Dr. Miller performed a six-month shoulder and elbow surgery fellowship in Sydney, Australia. Dr. Miller has made presentations on pediatric distal radius fractures at the American Society for Surgery of the Hand and the American Academy of Orthopaedic Surgeons. He has also been published in the *Journal of Bone and Joint Surgery* and *American Journal of Orthopaedics*. After 14 years in Boston, Dr. Miller is eager to move closer to family in Colorado. He will be joined by his wife Jennifer.

**Doug Wyland, M.D.** – Dr. Wyland earned his undergraduate degree in biology from the University of North Carolina at Chapel Hill, where he achieved outstanding honors as a wrestler, culminating in his being named to the U.S. Wrestling Team. He was president of his class at UNC School of Medicine and worked on a study on the effects of nerve injury on ligamentous healing which resulted in a presentation at the Orthopaedic Research Society meeting. Dr. Wyland moved from Chapel Hill to nearby Durham and the residency program at Duke. His publications in *Clinical Orthopaedics and Related Research* and *Journal of Bone and Joint Surgery*, as well as presentations at various prestigious conferences, demonstrate his continued interest in research. Dr. Wyland is happy to spend a year in Vail, after many spent in North Carolina. ■

## Foundation Website Garner Honors

The Foundation recently inaugurated its redesigned website at [www.shsmf.org](http://www.shsmf.org). The purpose of the new website is to make available to the general public as well as to medical specialists information being generated as a result of the Foundation's orthopedic research. A generous grant from the **Steven and Michele Kirsch Foundation** provided the funding to develop the site. Steven Kirsch is the founder of Infoseek, one of the Internet's top search engines. As part of its educational mission, the Foundation makes its research results available to medical practitioners and the general public. Articles, studies, FAQ's, papers, and contact information are now available through the [www.shsmf.org](http://www.shsmf.org) website. The site has already won three awards for design and content. In presenting the 2001 "**Surfers Choice Award**," the reviewer noted, "The Steadman♦Hawkins Sports Medicine Foundation provides a simple and effective information-based website. Use of graphics is excellent, navigation is superb, and it is imminently clear as to its purpose. Our support of this site is essential to bringing awareness of its efforts in finding solutions to orthopaedic problems that affect so many people." The Foundation's site has also been honored with the **International Association of Web Masters and Designers' 2000/2001 and 2001/2002 "Golden Web" award**, presented to sites "whose web design, originality, and content have achieved levels of excellence deserving of recognition." ■

## Meet our Staff:

### Kevin Shelburne, Ph.D., Former NASA Engineer, Foundation Senior Staff Scientist



Kevin Shelburne, Ph.D.

Kevin Shelburne, Ph.D., may seem far away from the days when he worked with NASA to help design their International Space Station. He was Robotics and Flight Crew Systems Engineer responsible for the design and test of on-orbit construction tasks. But there's a lot of cross-over in the research he is currently conducting, especially if you look at Dr. Shelburne's

background. "It was those days I spent task planning for astronauts," he says, "that really sparked my interest in biomechanics."

Dr. Shelburne received his B.S. degree in mechanical engineering from Texas A&M University in 1985 and was awarded his M.S. degree in mechanical engineering (specializing in robotics) from Texas A&M in 1988. Before returning to graduate study at the University of Texas at Austin, Dr. Shelburne spent three years working on the International Space Station project at McDonnell Douglas Space Systems. In 1997, he received his Ph.D. in mechanical engineering from the University of Texas, this time specializing in biomechanics. His work focused on computer modeling and the simulation of human mechanics for the design of joint replacements, surgical procedures, and rehabilitation protocols. Before joining the Foundation, he spent three years as senior engineer for Lockheed Martin Astronautics in Denver and was responsible for the design and analysis of structures and mechanisms for the Air Force's new launch vehicle development. "After acquiring my Ph.D.," he says, "jobs in biomechanics were hard to find. So when I was asked to use computer modeling to help design rockets, I was glad to do it."

But it is in joint modeling where Dr. Shelburne is now spending most of his time. A major emphasis of the biomechanics research staff is in computer joint models of the knee and shoulder. Computer models allow us to simulate specific motions, such as walking or rising from a seated position or even landing from a jump. From these models, Dr. Shelburne and his staff can then determine and analyze what forces act upon specific structures in the knee joint, such as those that occur on the ACL. Scientists may then alter the model in a manner that the surgeon would in the operating room—i.e., simulate the surgery—and run the motion simulation again. "The great strength of computer models," says Dr. Shelburne, "is that they can take you places where you can't go any other way, whether it's inside a knee joint during activity or on a spacecraft in orbit."

Complementing his work at the Foundation, Dr. Shelburne is also an affiliate faculty member at the Colorado State University College of Veterinary Medicine and Biomedical Sciences.

"Working for the Foundation has been a terrific experience for me," says Dr. Shelburne. "Every day presents a new and interesting challenge." He and his wife Kathy have two children. Among his hobbies are mountaineering, skiing, mountain-biking and fly-fishing. ■

## (PATIENTS IN THE NEWS cont. from pg. 1)



Bill Schneiderman, professional ski patroller, Stratton Mountain Vermont

PHOTO: HUBERT SCHRIEBL

both performed by a surgeon in Boston. Within a few weeks of his second arthroscopy, Schneiderman was told that the source of his knee problem was the alignment of his leg. He would need a high tibial osteotomy, a procedure that would change the alignment of his leg and relieve the pressure on his knee.

"I knew nothing about a high tibial osteotomy," said Schneiderman. "My surgeon described the procedure in detail to me, and I concluded that it was extremely invasive—with long-term consequences."

Schneiderman also knew that although the operations his surgeon had performed were successful, he had not undertaken that many. So he decided to seek a second opinion. He remembered, at the same time, having read an article about Dr. Steadman in the *Wall Street Journal* eight years prior, a copy of which he "filed away for future reference." Schneiderman said he was aware of the professional athletes that Dr. Steadman had reassembled, but he never anticipated having the need to be "reassembled" himself. He received a second opinion from a surgeon in Boston, then packed his bags and headed for Vail. His visit to the Steadman-Hawkins Clinic was all it took to convince him.

"I was impressed by the concern that Dr. Steadman and Dr. Sterett had shown for me—by the intensity of our meetings and by the research that was being performed at the Foundation, which was in turn driving the clinical practice. I left the clinic unwavering about my decision to have my surgery there. I had developed a high level of confidence in the clinic staff, their skill, and the extent to which so many state-of-the-art resources were mobilized under one roof. I had never before seen anything like it. For me, there would be no turning back."

Schneiderman was asked, prior to surgery, if he would participate in a Foundation research project in which his gait would be evaluated prior to, and subsequent to, surgery. He willingly agreed. "This also gave me confidence. Where else in the world, I wondered, would this be going on? In retrospect, it was a great way to relieve any pre-operative anxiety."

Five months after surgery—Dr. Steadman performed the arthroscopy, Dr. Sterett the high tibial osteotomy—Schneiderman continues to make real strides. But it's taken work and dedication. He works out two to three hours a day with weights, cardiovascular aerobics and stretching exercises. Schneiderman attributes a great deal of success to the clinic's strong belief in passive motion—which begins immediately postoperatively and is a result of research undertaken at the Steadman-Hawkins Sports Medicine Foundation. "Yes, it's work," he says, "but the Foundation has developed a regimen that leads to success, so you simply follow it."

This was no simple case of recovering from surgery. Schneiderman speculates that that would have been "a lot easier." Instead, he is recovering from the 12 months that transpired between the time that he sustained his injury and had his surgery at the Steadman-Hawkins Clinic. "So I'm basically recuperating," he says, "from a pretty messy year."



What impresses Schneiderman most is the role that the Foundation played in his treatment. "It's my belief that the best medical practices are guided by science and clinical experience. Much of that science is the result of the research being carried out by the Steadman♦Hawkins Sports Medicine Foundation. During the course of my care, I witnessed first-hand the important contributions that the Foundation made to the care I received. I was evaluated in the biomechanics lab and cared for by renowned clinicians, which included Fellows of the Steadman♦Hawkins Sports Medicine Foundation.

"I've had the privilege of working in some of the world's finest hospitals, and beside some of the most brilliant clinicians and researchers. And I can say with unwavering confidence that I have never seen such talent and clinical capacities mobilized under one roof as they are at the Steadman-Hawkins Clinic and Foundation.

Today, five months after surgery, Schneiderman reports he is already functioning at a level far beyond that of his preoperative state. And for a health-care-savvy guy—for someone who loves to hike, bike and golf, as well as ski—that's more than good enough.

### ■ *(TIPS FROM BRONCOS cont. from pg. 1)*

prepare them physically for the everyday battle of professional football.

As you can imagine, injuries are extremely common in football. Fortunately, during camp there were no serious injuries, although there were some that put a handful of players out of commission for several weeks. Most commonly seen injuries were musculo-tendinous injuries followed by ligamentous sprains. Early on, muscle pulls were extremely common, with hamstring and groin pulls topping the list, most likely due to a lack of hydration, lack of conditioning and/or poor flexibility. As we got further into the pre-season, the increase in full-contact practices and fatigue led to an increased number of ligamentous injuries. In that category were several ankle sprains, minor knee sprains, and a few shoulder joint complications. As a training staff, the challenge we had to tackle was to ready injured players as quickly as possible to return to action. Every practice missed, every day lost was a mark against a player's chance to make the football team. There were 91 players in camp, and only 53 of them would make the regular season roster, so being able to prove their ability on the field was a must. Looking now at the 53-man roster, familiar faces from the training room are not so familiar on the list.

For muscle pulls, the most important remedy is to immediately begin moving it. For example, if a player went down with a hamstring pull we would stretch the muscle repeatedly, then have the athlete spin on a bike to keep the muscle from tightening up.

One of the worst things you can do after a muscle pull is nothing. Swelling, the laying down of scar tissue and guarding against the pain can cause the muscle to get extremely tight, making recovery time longer. Early on in the treatment of a muscle pull, the idea was to regain the range of motion. If the muscle heals in a tightened position, the chances of re-injury are much more common. Coupled with stretching, very gentle strengthening was introduced. For a quadriceps pull, simply tightening the muscle and holding the contraction for a count of five helped maintain some strength and relax the tissue. This type of therapy can be used for anything from a calf strain to a sore muscle in your neck.

With the amount of money invested in each player and the success of the team riding on the players' health, we had to pull out all stops. Injured players would come in for treatment four times a day. The use of modalities was prevalent. In particular, ultrasound was used once a day to stimulate healing in the tissue. Interferential electrical stimulation, used up to four times a day, helped reduce the pain and relax the injured area. Retrograde, deep tissue and cross-friction massage techniques were also used to break up adhesions, drive the swelling out of the area, and improve elasticity. Typically, heat was used at the beginning of treatment to warm the muscles and provide blood flow, but ice was a must after every treatment session for up to every hour in between to decrease swelling and pain. Mind you, these athletes are expected to be back on the field within days. For the average recreational athlete, time frames will differ, as will aggressiveness with rehab.

The same general principles apply to ligamentous injuries. Range-of-motion exercises and the use of modalities were used in excess to maintain normal movement of the joint, to decrease the buildup of adhesions, and to decrease swelling. With a ligament insufficiency, the joint loses some of its stability. The severity of the sprain will dictate the treatment approach and in some cases lead to bracing during play and, in more serious cases, surgery. As an example for all knee-conscious skiers, a grade III anterior cruciate ligament (ACL) sprain is reason for ACL reconstruction. Ligament injuries are much more difficult to treat because they take longer to heal due to the lack of blood supply—and when they heal they tend to be less elastic than before.

Once range of motion was established with the injured players, a variety of strengthening and stabilization exercises were used to strengthen the muscles around the joint to take the stress off the ligament itself. For example, if a player injured his knee's MCL (medial collateral ligament), we would have him strengthen his quads (front of knee joint), hamstrings (back), abductors (outside-lateral) and the adductors (inside-medial) to decrease the incidence of re-injury.

One of the most effective tools we had for strengthening following any injury was a pool. Not only did the resistance of the water un-weight and strengthen the player, it also helped improve the confidence and trust in the injured body part. Using an ankle sprain, for instance, the player would start with walking exercises—forward, backward and side-to-side. As the comfort and ease of these exercises progressed, so did the level of difficulty. Speed would be added to the exercise, starting with a light jog, and when the player was ready, a full-speed jog. When improvements in strength and stability were evident, agility and cutting exercises were introduced. After the player was comfortable with all exercises in the pool, the same activity would occur on the field, starting with 25 percent agility exercises and running, progressively working up to being practice- and game-ready.

In the training room, strengthening exercises consisted of several sport cord stabilization exercises, balance work, and either elastic resistance training or weight training. For back injuries, most strengthening exercises were done on a Swiss ball.

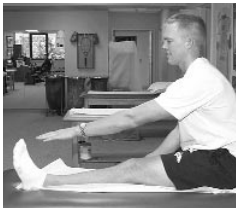
(Continued on page 10)

The speed with which these players returned to the field was certainly not what an average recreational athlete should strive to achieve. (Often a player would overplay his pain, allowing a relatively minor injury to stay with him for too much time. But in the life of the NFL there is always someone waiting to take over a position.)

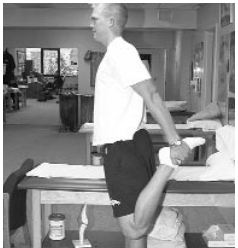
If an injury occurs that is muscular or ligamentous, the old acronym RICE—rest, ice, compression, elevation—still applies. However, after working with the Broncos and hundreds of athletes at Howard Head Sports Medicine Center, I believe three more letters should be added—RICEROM (rest, ice, compression, elevation and range of motion). The benefits of maintaining flexibility and mobility cannot be overemphasized.

The first exercise we have a patient do after injuring his or her knee on a ski mountain is wall slides, which helps to straighten and bend the knee. Prevention is the key to avoiding injury, and here are a few things you can do to help stave off injury:

- Stretching
- Strengthening
- Aerobic conditioning
- Hydration



Hamstring Stretch



Quad Stretch



Calf/Achilles Stretch



Groin Stretch

## Exercises

Stretching before and after a workout is important, but getting into a routine of stretching twice a day, even on days you don't work out, will drastically decrease the chance of a muscular injury. When getting back to skiing, or any sport, for that matter, pre-season strengthening and conditioning exercises will improve performance, technique and stamina. And remember, when fatigue sets in, injury is not far away. If an injury occurs, see your physician. Finally, when rehabilitating, the advice from a trainer or physical therapist can greatly improve your chances of a speedy recovery.

## Stretches to Help You Stay Healthy on the Slopes.

**Hamstring Stretch** - Sit with your legs out straight, slowly reach for your toes, keeping your back straight. You should feel the stretch on the back of your thigh.

**Quad Stretch** - Grab the ankle of the leg to be stretched and slowly pull it towards your butt. You should feel the stretch on the front of your thigh.

**Calf/Achilles Stretch** - Stand facing a wall. Put one of your legs back with your toes facing forward and your heel on the ground. Lean forward, feeling a stretch on the back of your lower leg.

**Groin Stretch** - Stand with your legs spread apart as far as tolerable. Lean

to one side, feeling the stretch on the inside thigh of the opposite leg. Hold each stretch for 10-15 seconds, performing three stretches of each. Stretching should be done before activity, to avoid muscle strains, and also afterwards, to avoid tightening up. ■

## (RESEARCH UPDATE cont. from pg. 1)

these growth factors, in the protein form, to joints to both inhibit breakdown using a specific protein that causes degradation or alternatively add additional protein that promotes growth and therefore cartilage repair. However, a number of challenges have arisen with direct protein therapy in this situation. They include (1) the need for repeated injections of either interleukin-1 receptor antagonist protein (IRAP) (which inhibits IL-1) or alternatively repeated injections of a positive growth factor such as IGF-1, and (2) carrier vehicles, to obviate the need for regular repeated injections, which can cause their own reactions and problems within the joint.

Gene therapy offers an alternative means of providing long-term administration of a protein that could benefit a damaged joint. As discussed by Dr. Rodrigo, growth factors are made up of sequences of amino acids, and it is the sequence of these amino acids that gives the growth factor or cytokine its specific structure. The amino acid sequence is dictated by the DNA sequence. The principle of gene therapy is that the gene for a specific protein is isolated and administered to the joint. This gene, with its specific DNA sequence for a particular protein, then travels into the nucleus of the cells of the joint and can start dictating increased manufacture of the desired protein. In work carried out at the Orthopaedic Research Laboratory at Colorado State University and headed up by Dr. David Frisbie and me, gene therapy has been successfully performed to inhibit the development of osteoarthritis in the horse's knee. Further, work funded by the Steadman-Hawkins Sports Medicine Foundation is about to commence at CSU using gene therapy to aid the cartilage healing response after subchondral microfracture.

## Gene Therapy to Inhibit Osteoarthritis

Osteoarthritis commonly progresses from acute joint injury. In a study recently completed at CSU, the specific gene for interleukin-1 receptor antagonist (the normal antagonist of interleukin-1) was cloned by Dr. Rick Howard.

Interleukin-1 is considered at the top of the cascade of degradation in osteoarthritis, leading to the degradation of articular cartilage. David Frisbie took the gene for IRAP and, using an adenoviral vector (developed in collaboration with Drs. Chris Evans, Paul Robbins and Steve Ghivizzani at the University of Pittsburgh), injected the gene and vector into the joints of horses with experimentally developed osteoarthritis. Initial work had been done in vitro (in tissue culture) to demonstrate that we could successfully inoculate the gene into synovial lining cells of the joint and get these cells to produce the desired protein. We then showed that with a single injection in vivo an ideal dose of gene and virus could produce prolonged production of protein in the joint. This single dose of gene and adenovirus was then injected into joints developing osteoarthritis in the horse, which demonstrated a very effective suppression of cartilage degeneration. The additional potential for this therapy in humans is quite exciting, since a single injection gave prolonged anti-arthritis effects.

## Promotion of Cartilage Repair with Gene Therapy

In this experiment, which will soon begin, the investigators at CSU (in collaboration with Dr. Alan Nixon at Cornell University) are going to combine gene therapy with IRAP (to inhibit degradation) using the insulin-like growth factor (IGF-1) gene that Dr. Nixon has cloned in his laboratory. The combined genes will be injected into joints with fresh full-thickness articular cartilage defects. The hypothesis of this research is that the combination of anti-degradative effects of IRAP and anabolic effects of the growth factor IGF-1 will improve the articular cartilage repair in full-thickness defects that have also received subchondral microfracture. The genes will be injected intra-articularly immediately following surgery. At the present time, the options for cartilage repair over and above the improved amount of tissue realized with subchondral microfracture are transplantation techniques that have substantial surgical morbidity. It is generally required that cartilage be taken from somewhere else in the patient's knee and then cultured. Gene therapy offers a far more convenient and less expensive alternative for the patient, and a second surgery would not be required. The potential of this procedure, if this gene therapy technique further augments the healing of articular cartilage defects, is extremely exciting. ■

## Measuring Shoulder Motion: A Biomechanics Research Pilot Study

### First step in developing shoulder computer model

By Kevin Shelburne, Ph.D., senior staff scientist, Biomechanics Research Laboratory

Motion of the shoulder has traditionally been difficult to quantify due to the complex arrangement of bones in the shoulder joint. However, understanding shoulder motion is important to clinicians and therapists who strive to re-create normal motion in patients with shoulder pathology. In particular, scapulo-humeral rhythm, or the motion of the upper arm in relation to the scapula, or shoulder blade, is vital to normal shoulder function and is thought to be disrupted in pathological shoulder conditions, such as impingement and instability. Unfortunately, it is difficult to measure and quantify normal scapulo-humeral rhythm due to the scapula's complex motion underneath the skin of the back.

The lack of an accurate measurement technique has plagued the medical community for years. As a result, no scientific agreement has been reached on ideal scapula and humeral movement patterns during exercise. This past fall, the Biomechanics Research Laboratory (BRL) sought to precisely measure scapulo-humeral rhythm. Using a novel technique, BRL researchers measured the relative motion of the upper arm relative to the scapula and torso. Stainless-steel pins were placed through the skin and into the shoulder bones of a volunteer subject. Reflective markers were then attached to the ends of the pins.



*Surgeons placed stainless-steel pins into the shoulder bones of the test subject.*



*In the laboratory, reflective markers were placed on the pins so that motion of the bones could be tracked with a video camera.*

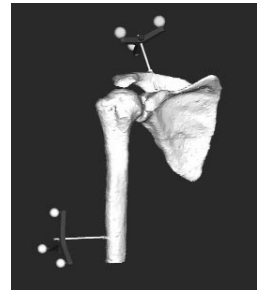
The motion of the markers was then tracked with five video cameras as the subject performed simple movements of the shoulder. The advantage of the bone-pinning procedure was that researchers were able to track and measure the movement of the bones as the subject performed simple exercises. Traditional techniques that measure the motion of reflective markers on the skin produce inaccurate results because bones glide beneath skin and the soft tissues that cover them. A secondary purpose of this study was to show the amount of error between traditional techniques and the precise measurement using bone-pins.

One of the challenges of this shoulder study is the processing of the data. Once the relative motion of the shoulder bones has been precisely measured, this motion must be related to the bones of the subject. To do this, the subject was placed in a CT scanner immediately following measurement of motions of the reflective marker.

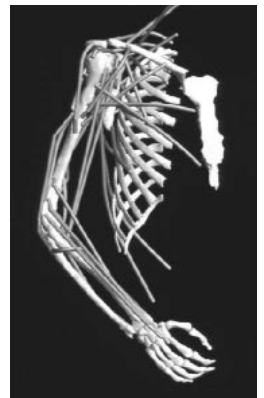
From the CT scan, the shoulder bones were reconstructed in three dimensions in the computer, including the reflective markers and stainless-steel bone-pins. In the computer, the motions of the shoulder bones during the exercises the subject performed can be animated. The computer shows how the bones move relative to one another during the exercises. In this way, BRL researchers are able to precisely quantify and visualize normal scapulo-humeral rhythm.

The collection of accurate shoulder bone motion data is also valuable for use in sophisticated computer models of the shoulder. Recently, the BRL, in collaboration with the University of Texas at Austin, began development of a model of the human upper extremity, including the bones and muscles of the upper torso, shoulder, arm and wrist. Knowledge of normal shoulder motion as measured in the bone-pin study allows comparison of the motion of the shoulder model to true shoulder motion. In this way, researchers are able to validate that the model performs as humans do. Once validated, the model can be used to estimate important data, such as the amount of shoulder load produced by various rehabilitation exercises.

The accurate measurement of shoulder motion is a big step toward resolving the mystery of scapulo-humeral rhythm. Data may need to be collected from additional volunteers, but the results of this pilot study have provided important data not only for clinicians but also for the development of sophisticated computer models of the shoulder. ■



*The subject's shoulder bones were reconstructed in three dimensions from CT data.*



*Model of the human upper extremity developed at the University of Texas at Austin. The results of the bone-pin study will aid in the further development of the model in collaboration with the BRL.*

The Steadman◆Hawkins Sports Medicine Foundation is dedicated to keeping people of all ages physically active through orthopaedic research and education in the areas of arthritis, healing, rehabilitation and injury prevention.

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## Mark Your Calendar

#### March 23-24, 2002.

Steadman◆Hawkins Sports Medicine Foundation All-Star Ski Treasure Hunt, Vail, Colo. Ski with Steadman-Hawkins Olympic and World Champion Alumni. Call Rachele Palmer, (970) 479-5809, for more information.

#### August 15-17, 2002.

Vail Cartilage Symposium. The Lodge at Vail, Colo. For more information contact Greta Campanale, (970)-479-5782 or e-mail [greta.campanale@shsmf.org](mailto:greta.campanale@shsmf.org).

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