Sandia Orthopaedics Alumni Society (SOAS) provides services that enhance and enrich the educational experience of current residents and fellows in orthopaedics training at UNM. With more than 40 years of alumni to call on, SOAS is a vital and dynamic contributor to the program. We thank them for their generous support of the University of New Mexico Orthopaedics Research Journal.

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Clinical Expertise: Spine and Trauma

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Brett Mielke MD
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I am pleased to present the fourth volume of the University of New Mexico Orthopaedics Research Journal. As the premier academic orthopaedic training program in the state, the University of New Mexico (UNM) Department of Orthopaedics & Rehabilitation provides services and information to benefit the people of New Mexico and orthopaedic practitioners who care for them—something we have done with distinction for 45 years now. Our entire group of residents, fellows, nurse practitioners, physicians, physician assistants, and staff members function as a supportive community and family with the same purpose. Furthermore, the popularity of the program extends beyond UNM and into national recognition. But this journal is quite special. Our research continues to prosper under the leadership of UNM faculty and financial support of the Sandia Orthopaedic Alumni Society (SOAS), allowing us to share state-of-the-art orthopaedic information with our many partners in New Mexico and the Southwest. I am proud to discuss several of our accomplishments during the past year.

As evidenced by this journal, research productivity at the UNM orthopaedics department continues to develop. The total number of publications increased from 12 in 2009 to 62 in 2014. We are very grateful for the leadership provided by Drs. Deana M. Mercer, Christina Salas, and Thomas A. DeCoster, with Dr. Mercer serving officially as the director of research. Our appreciation also goes to Dr. Gehron P. Treme, the program director, for his initiative in helping residents complete requirements of the Accreditation Council for Graduate Medical Education to become experienced in research activities. Lastly, my thanks to the many attending physicians, residents, and medical students who create such excellent presentations and publications. The addition of a research incentive program along with the invaluable dedication from Dr. Mercer has fueled scholarly pursuits in the department. This journal was the dream of many, and reaching the fourth edition makes me reflect on the interest and desire of Mary A. Jacintha to create it.

Our faculty continues to grow. Last year, the department welcomed Drs. Christina Salas, Cory V. Carlton, Jessica C. McMichael, Dustin T. Briggs, Charlotte E. Orr, and Urvij M. Modhia. We are very excited to bring in Drs. David M. Bennett (pediatric orthopaedics) and Eric J. Lew (pediatric orthopaedics and member of upcoming “Toe and Flow” Program for diabetic foot care) later this summer. We are also thrilled with the inclusion of Sandoval Regional Medical Center (SRMC) for our orthopaedic inpatient care. I would like to thank UNM and SRMC faculty for helping our practice become even more robust, particularly Drs. Paul G. “The Colonel” Echols and Daniel C. Wascher whose efforts make SRMC a successful practice site. Dr. Echols has been the remarkable “glue” between two locations, with his influential support of our orthopaedic trauma room on main campus and phenomenal 4-year leadership at SRMC. Dr. Echols officially retires in June 2015, and we wish him well and are humbled by his many years of initiative and hard work at UNM orthopaedics department. We look forward to Dr. Wascher’s upcoming sabbatical in Lyon, France, and know he has been studying French religiously!

We hope all the best for our five senior residents as they end this phase of their careers and begin new ones. Dr. Heather K. Woodin will do an orthopaedic trauma fellowship in Scottsdale, Arizona. Dr. Scott D. Evans will leave for a hand and upper extremity fellowship at the University of Virginia in Charlottesville. At the Campbell Clinic in Memphis, Tennessee, Dr. Sean D. Evans will perform his orthopaedic trauma fellowship. Dr. Dustin L. Richter will complete his sports medicine fellowship at the University of Virginia in Charlottesville. Finally, Dr. Gregory C. Strohmeyer is going to Sacramento, California, for his orthopaedic traumatology fellowship. We are so proud of this year’s resident class, and I am grateful for the support of their family and friends because these five Docs have worked extremely hard to become board-eligible orthopaedic surgeons. Heather, Scott, Sean, Dustin, and Greg, we are most proud of your accomplishments. I, along with the entire department, thank Dr. Treme for his outstanding leadership in the overarching education of UNM orthopaedic residents.

I am pleased to add that our division of physical therapy,
under the direction of Dr. Burke Gurney, has grown into an amazing education jewel for New Mexico. The division now has 10 full-time faculty members with expertise in orthopaedics, adult neurology, pediatrics, acute care, geriatrics, and cardiopulmonary physical therapy. These educators (and practitioners!) oversee three cohorts of 30 students who, after successfully completing the 3-year program, obtain a Doctor of Physical Therapy. The physical therapy division celebrated its 40th anniversary this past year and had a recent accreditation review that highlighted many fantastic achievements.

We did suffer loss and sadness at the UNM orthopaedics department with the passing of phenomenal surgeons: Drs. Dale V. Hoekstra, a beloved pediatric orthopaedic surgeon, team leader, and residents’ advocate; George E. Omer, the first chairman of the department and world-renowned hand surgeon; Elizabeth A. Stalay, a nationally respected pediatric orthopaedic surgeon, outstanding researcher, and tireless women’s advocate; Richard V. Worrell, a great resident mentor who for years directed our orthopaedic tumor service at UNM; and John M. Veitch ("Papa Veitch"), a hand surgeon, educator, and the father of current faculty member, Dr. Andrew J. Veitch. For details on the remarkable accomplishments of these five esteemed faculty members, please visit http://orthopaedics.unm.edu/common/forms/orthopaedics_mourns.html.

I want to thank our loyal alumni of SOAs for their enormous dedication and support, which includes hosting three annual events. The Eric Thomas Memorial Golf Tournament is held every September in honor of Dr. Eric A. Thomas (Class of 2004), in which we see alumni from all over the country enjoying Albuquerque’s great fall weather at the UNM Championship Golf Course. Additionally, the Joel Lubin Visiting Professorship lecture series occurs every spring to pay respects to Dr. Joel W. Lubin (Class of 2001), joined again this past April by Joel’s loving wife, Jennifer Lubin. And, thirdly, we always look forward to visiting with alumni at the SOAS-sponsored reception during the annual meeting of the American Academy of Orthopaedic Surgeons.

The assistance of alumni becomes more important to the UNM orthopaedics department every year. SOAS, created exclusively for graduates of our program, has a new lifetime membership available for a pledge of $25,000 to the Sandia Circle ($5000 every year for 5 years). I am a proud funder and lifetime member of SOAS and invite you to join me in becoming one, too. This is an exciting time to participate in the growth and success of our department. In addition to supporting the publication of this journal, you at SOAS support our outstanding resident surgeons.

It has been another great year at the University of New Mexico Department of Orthopaedics & Rehabilitation.

We express our sincerest gratitude to you—the alumni, faculty, and general community—for your continued support.

Thank you.
Robert C. Schenck Jr, MD
Professor and Chair

We thank all the contributors to this production—as well as Mary Jacintha, Department Administrator; Sahar Freedman, Copy Editor; Hannah Stangebye, Layout Editor, and Joni Roberts, Residency Coordinator and Managing Editor—whose work and dedication were instrumental in bringing the journal to fruition.

We invite you to explore this selection of recent department publications and hope that they inspire thought, discussion, and future research ideas and contributions.


Sincerely,
Deana Mercer, MD
Christina Salas, PhD
Co-Editors
Letter from the Residency Director
Gehron P. Treme, MD

We have long prided ourselves on the strength of family within the University of New Mexico (UNM) Department of Orthopaedics & Rehabilitation, and no time in recent memory has tested that strength more. As we put the wraps on another year, the opportunity to honor and congratulate our graduates—Drs. Scott D. Evans, Sean B. Kuehn, Dustin L. Richter, Gregory C. Strohlmeyer, and Heather K. Woodin—has come once again.

This year, however, we also reflect on the members of the UNM orthopaedics family that we will not again pass in the halls, share a laugh with, or whose wisdom and sage advice we will no longer enjoy. We heard about the need to be mindful and live in the moment; that is, to be present and participate fully instead of looking always to the next day, the next case, the next patient, or the next deadline. We have been counseled that letting our emotion run its course is healthy—advice that seems particularly pertinent. Finally, we are no doubt reminded that our legacy is built on how we treat each other every day far more than any one of our accomplishments.

We have all enjoyed watching this group of chief residents move through our training program for the past 5 years. This is the first group that I had the good fortune of meeting initially as medical students on their rotations and interviews. The growth and maturation of these individuals into skillful, practical, and thoughtful clinicians credits their hard work and quality of character. They are leaving our department and family better than they found it. Like all members of a family, we hope each one will continue to support, guide, and help train the young physicians that have chosen their same path.

Thank you, Scott, Sean, Dustin, Greg, and Heather, for your time, hard work, and diligence. Thank you more, though, for the personal stamp that each of you has left on our department. I will miss having you around and know that you will all make us proud. It is an absolute pleasure to call you graduates of the UNM Orthopaedic Residency program.

It has been another eventful year for the University of New Mexico (UNM) Division of Physical Therapy. We graduated our 38th class last June, which was our 3rd class of students obtaining a Doctor of Physical Therapy (DPT). Our graduation rate is steady at about 95%, with about 75% of our graduates staying in New Mexico. We are pleased to report a 100% passage rate on the National Physical Therapy Exam for the last two of our DPT-graduating classes.

The division continues to fill faculty positions. Our last two vacancies were resolved with the much-welcomed additions of Jodi R. Schilz, PhD, and Deborah L. Doerfler, DPT, PhD, OCS. Dr. Schilz is a basic scientist who is helping further develop the research component of the physical therapy division. Additionally, she will be teaching courses on pharmacology, pathology, and research design. Dr. Doerfler, who was already an adjunct faculty member, will continue to teach the gerontology component of the curriculum. She will also lead the orthopaedic treatment education. She will also continue to teach the gerontology component of the curriculum. She will also lead the orthopaedic treatment education. She will also continue to teach the gerontology component of the curriculum. She will also lead the orthopaedic treatment education. She will also continue to teach the gerontology component of the curriculum. She will also lead the orthopaedic treatment education. She will also continue to teach the gerontology component of the curriculum. She will also lead the orthopaedic treatment education. She will also continue to teach the gerontology component of the curriculum. She will also lead the orthopaedic treatment education.

The research aspect of the motion laboratory is in full swing, with several exciting projects in the works. We are pleased to have new collaborations with the neurology department in studying cervical proprioceptive deficits secondary to minimally invasive spinal surgery; a doctoral student of exercise physiology in analyzing the effects of gait retraining in runners with patellofemoral pain; and the athletic training department in examining the effects of postural training exercises on highly conditioned athletes.

Additionally, several case studies are being performed, including one that describes the effects of serial casting on walking kinetics and kinematics in treating children with idiopathic toe walking. Finally, Drs. Schilz and Kathy A. Deruif are developing a grant to fund research on the effects of an upper-extremity sling on gait parameters in patients with acute post-cerebrovascular accidents. The sling was invented by a physical therapist and occupational therapist here in New Mexico.

James G. “Bone” Dexter, the director of our motion laboratory, is working with Dr. Jessica C. McMichael and others to develop clinical use of the facility. Dr. McMichael, a faculty member and pediatric orthopaedic surgeon, will be the medical director of the laboratory. Although the process of approval has been slow, it looks favorable to begin as early as this fall in performing gait analysis on children to help with intervention decisions.

Other projects in the making involve increasing the clinical practice of faculty members (perhaps by adding a free-standing clinic) and including a pro bono, student-run clinic. Both of these projects are in the beginning stage, showing promise in the foreseeable future.

In summary, UNM Division of Physical Therapy is proud of the many accomplishments of our students and faculty. We have found and continue to find ways to better serve the communities of our students, our profession, and our state.

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Letter from the Chief of the Division of Physical Therapy
Burke Gurney PT, PhD, OCS

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Peripheral nerve injury (PNI) can be a devastating and life-changing condition, normally caused from traumatic and iatrogenic events. Proper treatment of PNI remains difficult, with less than half of surgical procedures resulting in good or excellent outcomes. Subsequently, physicians should be aware of important principles that can help with management of acute PNI. I reviewed studies on PNI involving anatomy and classification schemes; workup such as electrodiagnostic tests, imaging procedures, and surgical indications; and operative treatment options (including nerve repair and use of nerve grafts and conduits, and nerve, muscle, and tendon transfers). Although treatment of these injuries continues to present a challenge to surgeons, a clear understanding of nerve anatomy and injury classification can be helpful in determining the indication and timing for surgical intervention, which may lead to successful outcomes.

Introduction

About 200,000 peripheral nerve repair procedures are performed in the United States every year.1 Peripheral nerve injury (PNI) usually occurs in young healthy individuals and disproportionately affects the upper extremity.2 The mechanism of injury can include laceration-, crush-, blast-, stretch-, chemical-, thermal-, and avulsion-type events. The successful management of PNI includes maximizing motor and sensory capabilities.

Because of advancements in microsurgical techniques and understanding of nerve pathophysiology and internal topography, treatment outcomes of PNI repair have improved in the last few decades. However, less than 50% of patients who undergo surgical repair or reconstruction obtain good or excellent results.3 To possibly highlight important principles of PNI that may aid surgeons in performing successful treatment, I reviewed and summarized general knowledge and studies on anatomy, classification, diagnosis, preoperative imaging, and treatment options of PNI.

Anatomy and Classifications

The most basic structure of the peripheral nerve is the axon, which is an extension from a motor or sensory cell body to a target organ. The axon is composed of a phospholipid bilayer and contains internally charged ions that create a negative resting membrane potential. Channels within the axon membrane permit passage of charged particles, eventually leading to an action potential.

Some axons are coated with a fat-like material called myelin that helps increase the conduction speed of the propagating action potential. A connective tissue layer called the epineurium surrounds an axon, and a group of axons (often with similar function) joined together is called a fascicle. A fascicle is surrounded by another connective tissue layer, the perineurium. The thickest and outermost connective tissue layer of a peripheral nerve is called the endoneurium, which often surrounds multiple fascicles. Injury to the axon and connective tissue layers delineates the classifications described by Seddon4 and Sunderland5 (Table 1).

Surgical Indications

Recovery from first-degree injuries, which are managed with observation alone, has been typically excellent and occurs within the first 3 months. Axon regeneration has occurred by 11 months and can be observed with a “traveling” Tinel’s sign. Second- and third-degree injuries have not usually required surgical management unless scar formation caused local constriction. In these situations, decompression and neurolysis may be indicated. In most fourth- and fifth-degree injuries, surgical treatment has been advised. However, distinguishing the second- and third-degree injuries from the fourth- and fifth-degree injuries can be challenging for surgeons, particularly in cases of closed trauma.

Immediate exploration and primary nerve repair procedures have been recommended for treating sharp-open injuries. In blunt open nerve injuries, exploration has been advised for suture tagging of the nerve-ends in preparation of a delayed repair. Additionally, saccing of the nerve can lead to poor outcomes if repairs are performed before 3 to 4 weeks (before the “zone of injury” can be delineated). Low-velocity gunshot wounds often involve a temporary loss of nerve conduction, which can be observed. However, high-velocity gunshot wounds often necessitate surgical exploration because the zone of soft-tissue injury is much more extensive. In stretch- and avulsion-type injuries to the brachial plexus, the timing of surgery has been somewhat controversial.

Workup

Electrodiagnostic Tests

Electromyography (EMG) and nerve conduction studies (NCS) have been used to diagnose PNI, define the location of injury, and monitor nerve recovery.4 Baseline electrodiagnostic tests should be performed 4 to 6 weeks (the results are nondiagnostic before 3 weeks) after the initial injury to evaluate for fibrillations. Results of testing first-degree injuries do not show fibrillations because isolated damage occurs to the myelin sheath that surrounds an intact axon, with observation alone subsequently indicated.

A clear presence of fibrillations, however, has often indicated an axonal injury (Sunderland II, III, IV, and V degree). At 12 weeks after the initial injury, repeat electrodiagnostic testing has been recommended to determine the presence of motor unit potentials (MUPs). If MUPs are absent at 12 weeks, the diagnosis of a fourth- and fifth-degree injury can be made and surgical intervention has been recommended. On the other hand, the presence of MUPs at 12 weeks has indicated continued observation because axonal recovery is expected.

Imaging Procedures

Ultrasound and magnetic resonance imaging (MRI) have been the most common imaging studies for assessing PNI.4 Images obtained from ultrasound can show axonal swelling, neuroma formation, and nerve laceration. This relatively inexpensive process has been limited in success by obesity, edema, and technician skill level. Although more expensive to perform, MRI has helped distinguish high-grade axonotmesis from neurotmesis.4 However, MRI has been described as less sensitive in detecting muscle denervation compared with electromyography.

Treatment

Nerve Repair

A direct tension-free repair of a peripheral nerve laceration has provided the most predictable outcome. Direct repair on an urgent basis, with use of a small non-absorbable suture, has been recommended for most lacerations. A study4 on sciatic nerves in rats reported improved long-term outcomes with use of a direct nerve repair performed at 72 hours (compared to 10 days and 30 days). No difference in outcome was observed between repairs performed at 4 weeks and 72 hours. Therefore, emergent repair performed the same day may not be necessary for all cases. Additionally, epineural and perineural repair techniques have been described.

Nerve Aliograft

When nerve gaps have been encountered and a tension-free repair has not been possible, nerve autograft can be used. Less important nerves, such as sensory-only nerves, may be harvested to span the defect. Gaps greater than 2.5 cm have often required a nerve substitute because even a 6% stretch on a nerve can result in severe dysfunction.4 Use of nerve allograft has been the current standard of care for nerve gaps and shows predictable results.

Nerve Allotransplantation

However, when the required amount of nerve length has exceeded the autograft availability, nerve allograft has been an option. Mackinnon et al4 found that use of peripheral nerve allograft provided necessary framework for axon regeneration but required temporary immunosuppression for an average of 18 months. The benefits of nerve allografttransplantation have included abundant supply of nerves, nerve matching (mixed motor and sensory), lack of donor site morbidity, and shorter operating times.11
Nerve Conduits

When a short nerve gap has been found, nerve conduits can be used to guide axonal growth without the need of autograft or allograft. Arteries and veins have been used as biological conduits, whereas synthetic conduits have been more commonly used and composed of collagen, polyglycolic acid, or caprolactone.1 The length of these conduits has been considered to be 3 cm.1,2 Specifically, the use of conduits has been described in treating digital nerve gaps because results have been excellent after treating short sensory nerve gaps.4

Nerve Transfers

Nerve transfer procedures have been less commonly performed compared with other methods for treatment of PNI. A nerve transfer has involved harvesting a functioning nerve to supply a target organ or intact distal nerve. An example would be the transfer of a portion of the median nerve, such as the anterior interosseous nerve (AIN), to supply the ulnar nerve. The function of the AIN can be sacrificed to preserve intrinsic hand function. A study by Liu et al.3 described promising treatment outcomes with nerve transfers, particularly relating to injuries of the brachial plexus.

Conclusion

A peripheral nerve injury can be a life-changing event, with limitations in sensation and motor abilities possibly leading to severe functional deficits. Proper workup in determining the severity of damage to the nerve axon and connective tissue can be essential for appropriate treatment. Direct repair using suture techniques is recommended for treating most of these injuries; however, use of nerve autografts, allografts, and conduits can be effective when a tension-free repair is not possible. Studies on nerve transfers are limited but have described promising results. Although most orthopedic surgeons may not perform nerve repair and reconstruction procedures, knowledge of appropriate workup and timing for referral is crucial for proper management and may help in successfully treating these challenging injuries.

References


Severely Deformed Extraarticular Fractures of the Scapula: A Review

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Abstract

Nonoperative treatment of severely deformed fractures of the scapula was historically common. However, the findings of newer research have challenged the notion that conservatively managing these fractures results in the most successful outcomes. In an attempt to possibly reveal important indicators for surgical treatment, I reviewed studies on scapula fractures involving scapular anatomy; associated injuries; and technological advances that have helped with fracture evaluation; and treatment outcomes between nonsurgical and surgical methods. Although a universally accepted classification scheme of scapula fractures does not exist, use of 3D reconstruction with computed tomography can help define the level and category of fracture deformity. Most fractures heal predictably well with nonoperative management, yet fixation techniques should at least be considered for treating severely deformed scapula fractures. Individualized factors such as patient characteristics, measurable fracture type, and associated injuries may help in determining possible indicators for surgical treatment.

Introduction

Cases of severely deformed fractures of the scapula have been increasingly reported, perhaps owing to improvements in emergency response services. Scapula fractures normally involve the scapular body, scapular spine, neck of the glenoid, intraarticular glenoid, coracoid and acromion processes, and disruptions of the superior shoulder suspensory complex (SSSC), commonly known as floating shoulder.1 Because of severe chest injuries often associated with these fractures,1,2 surviving patients require appropriate care. Multiple classification schemes have been devised to help surgeons decide this treatment.1,3 However, no standard method for categorizing scapula fractures exists. Measurements of the scapula are highly subjective to patient positioning, and the resulting classification systems are often unhelpful in devising surgical treatment, deciding fixation techniques, and indicating treatment outcomes. Subsequently, recent studies have questioned the general notion that these injuries are best treated with conservative methods.1,3 I reviewed research on scapula fractures (including scapular anatomy, accompanying injuries, technological advances for evaluation, and postoperative outcomes) to identify possible indicators for surgical treatment.

Anatomy of the Scapula

Scapular anatomy is complex, similar to the pelvis in nature. The bony anatomy includes the lateral border, scapular spine, vertebral border, acromion and coracoid processes, glenoid, and scapular body. Because of the intricate 3D shape of the scapula, conventional imaging has often failed in detecting fracture patterns.3,4 Nonunion is rare, however, because a muscular sleeve (both thick and vascular) covers the scapula.

Additionally, 18 muscular attachments originate from or insert into the bone. The suprascapular nerve provides motor function to the suprascapital and infraspinitus muscles, and the axillary nerve and posterior circumflex humeral artery deliver innervation and blood supply to the teres minor muscle. Surgeons should carefully consider these vulnerable neurovascular bundles during operative treatment.

Associated Injuries and Evaluation

Scapula fractures were historically associated with more severe injuries. In 1579, Ambroise Paré21 stated, “When the fracture involves the neck of the scapula, the prognosis is almost always fatal.” More than 400 years later, concomitant injury rates of 90% have been described,1 with most involving thoracic injuries such as pneumothorax, rib fractures, and pulmonary contusions.9 Recent mortality rates between 2% and 15% have been reported.5,10 These mortality rates have improved with better emergency care and the Advanced Trauma Life Support program (American College of Surgeons, Chicago, IL), which has played an important role in managing patients with scapula fractures. Initial radiographic evaluation has included a view of the chest (with attention to associated thoracic injuries), followed by anteroposterior, axillary, and scapula Y views of the shoulder if a scapula fracture was identified. Based on these radiographic findings, surgical treatment...
may be considered and most authors have recommended use of 3D reconstruction with computed tomography (CT) to help assess displacement of the fracture.

The use of 3D reconstruction with CT has shown more success in detecting adequate and consistent measurements of scapula deformity. A retrospective review by McAdams et al.11 found no improvement in interobserver reliability when using routine CT scans compared with radiography. Another study did not help identify injury to the SSC. On the other hand, Anavian et al.12 noted improved intra- and interobserver reliability with the use of 3D CT and reported reliable measurements of medial/lateral (M/L) displacement, angulation, translation, glenospheral angle (GPA), and glenoid version.

Non Surgical Management and Outcomes

Cole et al.13 recommended use of a sling for 2 to 3 weeks in most patients with scapula fractures, and also suggested monitoring the condition weekly for progressive displacement. When shoulder pain had subsided, a full and passive range of motion was allowed for patients, advancing to active range of motion at 4 weeks. A progressive strengthening program began at 8 weeks after the initial injury, with a goal of no movement restriction by 3 months.

Nonoperative management, however, has been described with unsuccessful outcomes. A long-term outcome study by Ada and Miller14 reported failures of 24 patients with scapular fractures treated nonoperatively, in which particular pain and weakness were associated with scapular neck fractures of more than 40° and 1 cm of angulation and lateral border displacement, respectively. Romero et al.15 retroactively reviewed 19 patients (mean follow-up of 8 years) with scapular neck fractures and found that a GPA of less than 20° predicted poor outcomes, including moderate or severe deformed extra-articular scapula fractures. So far, techniques should at least be considered for treatment of severely deformed extra-articular scapula fractures. Therefore, after treating patients such as manual laborers and physically active individuals appear good and reliable.

References

Learning the LaPrade Technique for Reconstruction of the Posterolateral Corner of the Knee

Dustin L. Richter, MD*

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I have always been interested in research on multiligamentous knee injuries, as these are challenging problems for both patients and orthopaedic surgeons alike. My Chief Choice Grand Rounds this year was focused on reconstruction of the posterolateral corner (PLC) of the knee. Because of the complex anatomy and variable injury patterns of the PLC, a number of anatomical and non-anatomical reconstructions have been proposed.

These methods include biceps tenodesis, fibula-based reconstruction, combined tibia- and fibula-based reconstruction, and reconstruction of all or some of the posterolateral structures (the fibular collateral ligament [FCL], popliteus tendon [PT], and popliteofibular ligament [PFL]). Previous structures (the fibular collateral ligament [FCL], popliteus tendon, and popliteofibular ligament) were reconstructed with use of the Arciero or LaPrade technique. To make the study robust, several methods have been proposed.

Two of the most common procedures used for posterolateral knee reconstruction with good clinical outcomes are the LaPrade and Arciero techniques. In 2003, LaPrade et al described a landmark study about the anatomy of the knee. PLC and, in 2004, they reported the biomechanical results of FCL, PT, and PFL anatomical reconstruction using a two-graft technique. In 2005, Arciero described FCL and PFL reconstruction using free soft-tissue grafting through a transfibular tunnel and a dual femoral socket technique. Notably, the PFL was not reconstructed.

No biomechanical studies have evaluated the LaPrade and Arciero techniques in a head-to-head comparison. We at the University of New Mexico (UNM) Department of Orthopaedics & Rehabilitation proposed biomechanical testing on intact and sectioned human cadaveric knees that were reconstructed with use of the Arciero or LaPrade technique for PLC reconstruction. To make the study robust and help ensure data accuracy, we contacted Dr. Robert F. LaPrade to discuss reconstruction design variables and technique tips. Dr. LaPrade was kind enough to invite me to Vail, Colorado, to observe a day of surgery and participate in a cadaveric dissection and reconstruction of the PLC of the knee. With full support from the UNM orthopaedics department, and most notably, Dr. Schenck, who helped arrange this amazing opportunity, I graciously accepted the invitation.

In January 2015, I left Albuquerque on a snowy morning for my drive to Vail. I arrived in the town that evening and stayed next door to the Vail Valley Medical Center. The following morning, I met one of the sports fellows and a surgical assistant/athletic trainer for a quick orientation on the 3rd floor of the Steadman Clinic, where the walls were adorned with jerseys and memorabilia from athlete-patients who had received superb care there. I then met with Dr. LaPrade and had time for a brief visit before a busy operating day that began at 7:00 am. Five surgical procedures were scheduled: a knee arthroscopy with anterior cruciate ligament (ACL) cyst decompensation; two revision ACL reconstructions; a multiligamentous ACL and medial collateral/posterior oblique ligament reconstruction with lateral meniscus repair; and a medial patellofemoral ligament repair. Because of an ability to move quickly between two operating rooms and the efficiency of the staff, the operations were completed by 2:00 pm.

In the operating room, I was impressed with the team that Dr. LaPrade had set up. A fellow, surgical assistant, and an athletic trainer regularly scrubbed into surgery with him. I was able to observe... but was not alone. Also observing was another athletic trainer and a visiting physician from Chile who was spending 2 months in Vail working with Dr. LaPrade and had, interestingly, visited the UNM orthopaedics department as a Latin American Society of Knee Arthroscopy and Sports Medicine fellow in 2006. I learned four things about Dr. LaPrade’s technique: he uses a bone-patellar tendon-bone autograft for most ACL reconstructions (even in elderly patients because of the high physical activity levels in Colorado’s older population); he performs most revision ACL reconstructions as staged procedures with bone grafting and returns 6 months later for reconstruction; he regularly uses a posterosmedial portal for knee arthroscopy; and he prefers double-hundle technique for posterior cruciate ligament reconstruction.

A talk with Dr. LaPrade and his staff revealed that the clinic setup was ideal. For the past 24 years, questionnaires (now viewable on Apple iPads [Cupertino, CA]) have been given to each patient who presented to the clinic, making data collection for research much easier. Because of the mountain setting and scope of the practice, most patients are either referrals or have acute injuries. Patients with acute injuries can be examined, sent downstairs the same day for magnetic resonance imaging, and scheduled for a surgical procedure for the next day, if needed (as happened with one of the operations I observed, which was performed on a patient who, a day earlier, had been injured while snowboarding).

The next morning, time was set aside for a cadaveric dissection of the PLC of the knee. I met the team on the ground level of the Steadman Phillipson Research Institute and had the opportunity to see the exceptional research facilities and resources. Dr. LaPrade expertly dissected the PLC structures while I peppered him with questions about the procedure and our proposed biomechanical study (Figure 1). He showed me how to properly perform a full release of the peroneal nerve by incising the peroneous longus muscle overlying the nerve distally, and he dissected out the anatomical femoral origins of the FCL and PFL (Figure 2).

Dr. LaPrade and I discussed testing protocols, potting of specimens, and avoiding overconstraint of the PLC by securing the FCL graft at 20° of rotational/biarticular and the PFL/PT graft at 60° of rotational and biarticular. Although we often think that structures eventually become lax after a multiligamentous reconstruction, he recalled one patient who had an overconstrained knee and difficulty walking for 10 years after PLC reconstruction done elsewhere. Thus, Dr. LaPrade stressed the importance of appropriate positioning for tensioning grafts and avoiding internal rotation to avoid overconstraint and other problems.

This was a phenomenal learning and research opportunity for me. I know it will help me in my professional development and help our research team with the biomechanical study. Finally, I would be remiss if I did not mention Vail Ski Resort—what an awesome mountain to ski on before I returned to Albuquerque!

References
Full circumferential bone loss of the tibia commonly results from traumatic injuries (either acute bone loss or after debridement of contaminated or devitalized bone), chronic osteomyelitis, nonunion, and tumor resection. These traumatic injuries are often encountered in male patients after motor vehicle collisions, motorcycle accidents, gunshot wounds, falls, and crush injuries. The resulting open fractures (classified as Gustilo-Anderson grade IIIA or IIIB) usually occur in the tibia owing to its limited anterior soft-tissue envelope and subsequently can involve severe soft-tissue damage that necessitates coverage with either a free flap or rotational myoplasty. Additionally, the decision to perform debridement for treating an open fracture requires careful consideration because contaminated bone increases the risk of infection but aggressive removal may increase the size of the defect.

The choice of treatment method typically depends on the length of the defect resulting from bone loss. Shortening is generally used for treating defects less than 1 cm in length, which can create bony contact at the fracture site to encourage healing. Fractures are treated with fixation (with or without bone grafting) to fill defects greater than 1 cm but less than 3 cm. However, defects greater than 3 cm in length do not currently have a standard method of treatment. I reviewed treatment options for these larger defects, including amputation, allograft replacement, autograft bone grafting, use of vascularized fibular autograft, bone transport, and the Masquelet technique.

Older Treatment Options

Amputation

Indicators for primary amputation for treatment of open tibial fractures have included hemodynamic instability, partial amputation, more than 6 hours of ischemia time, a Mangled Extremity Severity Score of seven or greater, and transection of the tibial nerve. Loss of tibial nerve sensation, once thought as an indicator, has been reported to return several months after the injury. Complications after limb salvage that necessitate amputation have included persistent infection, ipsilateral injuries, vascular injuries, and discontinued long-term use of an external fixator device or a frame. A retrospective study on clinical and functional outcomes of limb salvage, Mekhail et al described shorter operating times but higher lifestyle costs for patients treated with amputation. In general, patients who underwent amputation later in their life may have been influenced by factors such as depression, divorce, and destitution after spending considerable time and resources on failed limb reconstruction techniques.

Allograft Replacement

Described in primarily oncological applications, the use of structural allograft has involved high rates of infection, stress fractures related to the graft, nonunion at the bone-allograft interface, and extended periods of time required for creeping substitution of new bone. Chmell et al found infection rates of 40% and amputation rates of 12.5% with use of allograft in the tibia. Although unreliable, the functional outcomes were good if the graft was successfully incorporated. Additionally, in a 24-year retrospective study, Sorger et al reported allograft fracture rates of 38.7% in the tibia at about 3.2 years after placement. These long-term complications have generally prevented allograft replacement from being a common treatment of acute traumatic injuries and associated bone loss.

Autograft Bone Grafting

Posterolateral bone grafting was described in a study by Harmon in 1945 as one of the first reliable salvage techniques that could avoid damaged anterior soft-tissues, which had been a notable limitation before the use of free-flap coverage. Large amounts of grafting material were used in a posterior approach to the tibia, fibula, and interosseous membrane to help create synostosis between the tibia and fibula. However, successful treatment (about 40-50 weeks to consolidation) required more time than the anterolateral approach and lifetime bracing was often necessary because of injury-related damage to the membrane. Direct anterolateral grafting became a viable option after the development of microvascular surgery, which allowed soft-tissue transfers to cover the anterior tibia defect. This soft-tissue flap coverage decreased the risk of infection and provided a well-vascularized environment for consolidation. Additionally, the use of external or internal fixators before grafting provided stability to the construct. Wallace et al noted shorter total healing times, with external fixation achieved at about 5.5 months and full weight bearing possible at 4 months after fixator removal. Christian et al also used this technique and found large defects to heal after 9 months. Absorption of the grafting material did occur in some cases, requiring repeated grafting.

Modern Treatment Options

Use of a Vascularized Fibular Autograft

Vascular anastomosis with the anterior tibial artery could be achieved by transferring harvested contralateral or ipsilateral fibula to the defect, with the graft secured using screw or screw-plate fixation at the donor site and the use of an external fixator device during healing. Zhen et al recommended use of harvested grafts greater by 2 cm or more in length than the defect to allow proximal and distal placement of the fibula inside of the tibia and completed fixation. After healing and removal of the external fixator device, a study by El-Gammal et al described use of bracing to stabilize the graft and allow partial weight bearing, which protected the construct while waiting for hypertrophy of the graft to occur. Advantages of this treatment have included decreased infection rates owing to the immediate presence of viable bone after autograft transplant, the ability to use accessible osteosynthetogenic grafts to simultaneously treat associated soft-tissue defects; short operating times of external fixation; and time to full weight bearing depending on hypertrophy rather than the length of the bony defect. Drawbacks involved the typical need for a microvascular surgeon, short-term complications such as vascular occlusion, donor-site morbidity, stress fractures in the fibular graft because the bone went from minimal to primary weight bearing; and transient peripheral nerve palsy.

Bone Transport

A study by Ilizarov and Ledyayev was the first to describe a bone transport technique after debridement, healing of the soft-tissue envelope, transition from a traditional external fixator device to an Ilizarov frame, and corticotomy. The transported bone was “locked” at the opposite end of the defect (with or without bone grafting), and the frame was removed after complete osseous bridging. However, both the rate of healing in the docking site and consolidation of the bone limited the success of treatment.

Studies on bone transport have shown promising results. Rates of 0.5 mm to 1 mm per day per day has started 5 days to 7 days after corticotomy, with at most four individual adjustments daily. Time required for external fixation has been reported between 10.6 months to

Abstract

Full circumferential segmental bone loss of the tibia presents a challenge to orthopaedic surgeons. These open fractures often involve extensive soft-tissue damage, which can contribute to poor long-term outcomes even if the tibia is successfully reconstructed. Although amputation was historically used to treat full circumferential segmental bone loss of the tibia because of the severity of the injury, the development of new reconstruction procedures has provided the option of limb salvage techniques. I reviewed studies on treatment of traumatic tibia bone loss, focusing particularly on full circumferential bone loss of greater than 3 cm. Treatment options included amputation, allograft replacement, autologous bone grafting, use of vascularized fibular autograft, bone transport, and the Masquelet (induced membrane) technique. The most commonly used methods of limb salvage for treating full circumferential segmental bone loss are bone transport, use of vascularized fibular autograft, and the induced membrane method. Successful treatment, however, can depend on individual comfort levels of patients and physicians when deciding between the different approaches.

Introduction

A standard definition of segmental bone loss is not clearly stated nor agreed on by most authors, but two classification systems for the condition exist. Robinson et al presented one of the first systems that organized bone loss into trivial, moderate, and severe categories based on increasing size of defect shape (wedged or circumferential) and length. In this classification system, partial and full circumferential bone loss were often placed in the same category. Other classification systems include the Orthopaedic Trauma Association’s classification of open fractures, which takes into account bone loss and other factors such as contamination. This system differentiates between full and partial circumferential bone loss.
16 months.14,15 El-Gammal et al14 reported the average time to full weight bearing with use of bone transport at 11.8 months, with good to excellent results in 91% to 95% of acute traumatic injuries. However, 60% of patients had major complications that involved knee flexion contractures, loss of ankle motion, and malalignment. Lowenberg et al16 reported a low nonunion rate of 8.8% from traditional anterolateral grafting. This helped with the bone. Because this technique was relatively simple, it closed over the grafting material and allowed to consolidate osteoconductive additives. The membrane was carefully membrane and the defect was filled with osteoinductive and plate. About 4 weeks to 8 weeks later, the PMMA spacer first being debridement of the bone defect and placement of an antibiotic spacer made of polymethylmethacrylate of an antibiotic spacer. This technique has shown some promising results; however, El-Rosasy30 found that the restrictions of acute shortening depended mainly on location chosen in the bone with the defect, and another study31 described 10.3 cm of acute shortening without vascular complication. Using pulsed ultrasound, Gold and Wasserman32 noted decreased time required for healing and consolidation, with an external fixation time of 13.9 months and an external fixation index of 1.3 months/cm for acute injuries. In this study, patient medical history such as smoking, infection, and nonunion before surgery may have contributed to poorer treatment outcomes.

Masquelet Technique

The most recent method for treatment of large segmental defects was a procedure described by Masquelet et al,33 known as either the induced membrane technique or Masquelet technique. This technique involved at least two steps, the first being debridement of the bone defect and placement of an antibiotic spacer made of polymethylmethacrylate (PMMA). The tibia could be stabilized when the cement spacer was placed, or earlier using either an IM nail or plate. About 4 weeks to 8 weeks later, the PMMA spacer was removed while carefully preserving encompassing membrane and the defect was filled with osteoinductive and osteoconductive additives. The membrane was carefully closed over the grafting material and allowed to consolidate with the bone. Because this technique was relatively simple, special training was not required. The use of an induced membrane was a major difference from traditional anterolateral grafting. This helped successful treatment by preventing fibrous ingrowth into the area of the bony defect and resorption of the graft after placement. Additionally, an in vitro study by Aho et al34 reported that the membrane was a source of osteoinductive factors, including bone morphogenetic protein-2, which peaked in production at 4 weeks and decreased thereafter. Use of the membrane also caused differentiation into the osteoblastic lineage, helping bone formation and consolidation at the site of the defect. No external fixators were needed for most of these fractures, which avoided pin tract infections and difficulties of living associated with the device.

Studies have been mainly limited to short-term results. A study of acute trauma, infection, and nonunions byDonegan et al35 reported that 90% of patients had complete healing of the defect, with about 133 days and 266 days after fixation required for full weight bearing and consolidation of the bone graft, respectively. Another study36 described the Masquelet technique in treating a defect greater than 10 cm in length, which resulted in full weight-bearing and removal of the external fixator at 10 months and no long-term complications. Biau et al37 also noted successful treatment of long-bone segmental defects with the technique. In a review on defects ranging from 3.4 cm to 10.4 cm in length treated with a modified Masquelet technique using antibiotic beads, Rustemii et al38 found that healing time did not depend on the length of the defect, although distal healed faster than proximal tibia defects and diaphyseal defects were the slowest to heal.

Conclusion

Bone transport, use of a vascularized fibular autograft, and the Masquelet technique are reliable methods for treating defects greater than 3 cm in length. Both bone transport and the use of a vascularized fibular autograft require specialized training for successful treatment, but commonly necessitate the use of long-term external fixator devices that further complicate treatment. Bone transport and the Masquelet technique induce bone formation, which is often similar in size to native bone, whereas vascularized fibular grafts require hypertrophy of the graft. The Masquelet technique has shown some promising results; however, further studies are needed to verify its effectiveness for treatment. Ultimately, the decision for which approach to employ depends on surgeon comfort level with each specific technique.

References

Open Reduction and Internal Fixation for Treatment of Proximal Humerus Fractures: A Review

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Abstract

Fractures of the proximal humerus are common in older patients, and the incidence of these fractures in the United States is expected to notably increase with the aging population. Nonoperative procedures have been preferred in elderly patients with stable fracture patterns to avoid complications associated with osteoporotic bone. However, more complex and unstable fracture patterns often necessitate operative techniques to allow for more anatomical healing. Although proximal humerus fractures have been thoroughly examined, systemized, and studied, no clear method to choosing an appropriate surgical treatment or candidate has been accepted. I reviewed the role of the following factors on successful treatment with ORIF: anatomical structures; blood vessels and morphological features of the humeral head; clinical evaluation, assessment, and outcomes; and surgical variables such as approach to the shoulder, plating techniques, position and placement of screws, medial calcar supports, augmentation of implants, and level of experience and familiarity of surgeons with the operation. Based on the complex nature of proximal humerus fractures, effective surgical treatment may be determined by the circumstances unique to each case.

Introduction

Fractures of the proximal humerus are common, composing about 6% of all fractures.1 These typically result from low-energy trauma and thus rarely happen in younger individuals; occur more often in women than men; and rank as the third most common fracture reported with more than 1 cm of greater tuberosity displacement.2 Contraindications for ORIF have been criticized for poor interobserver reliability and reproducibility.3 Although an accepted algorithm to delineate treatment for proximal humerus fractures does not yet exist, options for treatment include ORIF, nonoperative management, closed reduction, minimally invasive techniques (reduction and reverse total shoulder arthroplasty. The goals of these procedures are to reduce the fracture, maintain reduction until healing is achieved, and restore shoulder function.

Relative indicators for ORIF have included head-shaft displacement greater than 50%, varus or valgus malalignment greater than 30°, and Neer three- or four-part fractures with more than 1 cm of greater tuberosity displacement.4 Contraindications for ORIF have been described as nondisplaced and minimally displaced fractures, head-splitting fractures in which fragments of the humeral head are unreconstructable, and anatomical neck fractures in older patients.5 In an attempt to correctly describe a method that could help lead to successful surgical treatment of proximal humerus fractures, I reviewed studies on the anatomical structures of the proximal humerus that serve as important reference points; role of blood vessels to the humeral head; factors affecting clinical evaluation, assessment, and outcomes; and variables affecting surgical outcomes and procedures.

Anatomy and Vascularity

The anatomy of the proximal humerus has been examined in great detail. In 1970, Neer5 described a classification system based on the displacement of major segments such as the articular surface of the humeral head, greater

References

tuberosity, lesser tuberosity, surgical neck of the humerus, and humeral shaft. This study reviewed both the importance of soft-tissue attachments in directing displacement and a possible relationship between surgical neck injuries and the presence of primary intramedullary fractures.

Establishing reliable landmarks with anatomical structures can be helpful in preoperative planning. The proximal humerus neck-shaft angle has been measured at about 130°, although a reference point for humeral length has been better established with the upper portion of the pectoralis major tendon (averaging about 5.6 cm distal to the top of the humeral head), retroversion may also be determined by prosthetic placement relative to the bicipital groove. The axillary nerve, which wraps posteriorly around the surgical neck of the humerus, has been generally found between 4.3 cm and 7.4 cm from the lateral tip of the acromion.

Understanding the role of blood vessels and adjacent nerves around the surgical neck may be critical in determining a treatment algorithm for proximal humerus fractures. The posterior humeral circumflex artery supplies most of the blood (64%) to the humeral head, with the remainder provided by the anterior humeral circumflex artery. Hertel et al. identified morphological features predictive of intraoperative ischemia did not predictably develop avascular necrosis. The effect of additional factors on both humeral head ischemia. However, a follow-up study of 74 patients treated with locking-plate fixation but a high complications rate of 48.8% and a reoperation rate of 13.8%.

Poor outcomes after surgery have been associated with severity of fracture pattern, initial varus alignment, and osteoporosis.

A retrospective review of 368 surgically treated proximal humerus fractures described reoperation rates as high as 38% in patients with type C fractures (AO classification) and 84% in those with initial varus displacement. Additionally, in a 2-year follow-up study of 74 patients treated with locking-plate fixation, significantly worse constant scores and frequent varus collapse were reported with initial medial calcar malalignment. Medial calcar comminution has been shown to decrease the mean load to failure of a locking-plate construct by 48%, yet use of a medial calcar screw can help increase the load to failure by 31%.

Fixation stability and failure rates have also been affected by the presence of osteoporosis. Tingart et al. found that a mean cortical thickness of less than 4 mm is highly indicative of a low bone mineral density and may be a relative contraindication for operative fixation.

Success and Challenges of Operative Treatment

Deltoid and Deltoid-Splitting Techniques

The deltopectoral technique, traditionally used to approach the shoulder, is the most familiar method, allowing for better visualization and reduction of the medullary canal and a more extensile exposure along the humerus shaft if necessary. Although less familiar to most orthopedic surgeons, the anterolateral or deltoid-splitting approach can allow for easier application of hardware laterally along the humerus.

Wu et al. examined these two approaches and described difficulties of the deltopectoral technique with extensive soft-tissue dissection, lateral placement of hardware, protecting the anterior humeral circumflex artery, and reducing the superiorly or posteriorly displaced fragment of the greater tuberosity. Disadvantages of the deltopectoral splitting include the risk of injury to the axillary nerve, posterior humeral circumflex arteries were injured in 80% of 368 surgically treated proximal humerus fractures. The posterior humeral circumflex vessels supply most of the blood (64%) to the humeral head, with the remainder provided by the anterior humeral circumflex vessels. Hertel et al. identified morphological features predictive of intraoperative ischemia did not predictably develop avascular necrosis. The effect of additional factors on both humeral head ischemia.

Clinical Evaluation and Assessment

Appropriate imaging has been important in evaluating fracture patterns of the proximal humerus. Radiographs of a standard trauma shoulder series typically have included a posterior-anterior view (tangential to the glenohumeral joint) and an axillary lateral view, and a scapular Y view. Additionally, results of computed tomography have helped classify complicated fracture patterns and decide preoperative planning.

Although not routinely performed, magnetic resonance imaging (MRI) has been useful in identifying torn rotator cuff injuries in patients with proximal humerus fractures.

Clinical assessment of injuries associated with proximal humerus fractures has also been important. Injury to the axillary nerve, which wraps posteriorly around the surgical neck of the humerus, has been generally found between 4.3 cm and 7.4 cm from the lateral tip of the acromion.

Secondary screw perforation, also known as cutout, is related to bone quality, number and location of screws, presence of a kickstand screw or medial calcar reduction, and quality of fracture reduction. Minimal pullout strength of screws has been noted in the superior-anterior region of the humeral head, an area which also had the lowest bone mineral density. In a cadaveric study, pullout strength was maximized when screw length reached the subchondral location, and increasing the number of screws reinforced overall strength of the construct. The cadaver group with use of 4 screws and an intertrochanteric plate had the most stable construct that showed the greatest resistance to secondary screw perforation.

Medial Calcar Support

The use of a medial mechanical support has been important for achieving and maintaining reduction. A follow-up study by Gardner et al. of 18 patients treated with and treated without a medial support reported an average of 1.2 mm and 2.8 mm of humeral head height loss, screw penetration in 1 patient and 5 patients, and subsequent revision surgery needed in 1 patient and 2 patients, respectively. Anatomical reduction of the medial calcar, medialization of the shaft with stable impact, and use of an intermedullary locking screw within 5 mm of the subchondral bone were vital for maintaining reduction.

Bony Augmentation

Use of allografts may be helpful in treating osteoporotic bone with a deficient medial calcar. In a biomechanical cadaveric study, Chow et al. found that a fibular strut model allowed for increased cyclic loading before collapse and less construct deformation between cycles. A surgical technique for allograft augmentation has been described, which required a 6-cm to 8-cm segment of fibula allograft.

The steps involved seating the graft so that 2 cm to 3 cm was positioned proximal to the level of comminution; drilling the lateral cortex in the plate; and inserting a screw of 5 mm longer than the measured length and subchased the allograft to hinge against the surgical neck. A follow-up study of 38 patients treated with use of endosteal strut allografts had excellent results, with a mean constant score of 87.
Proximal humerus fractures are common with older patients and subsequently tend to necessitate minimally invasive treatment. Most of these injuries involve stable fracture patterns and can be treated without surgical intervention. However, in extremely displaced or unstable patterns, operative treatment should be considered. Because of the high rate of surgical complications, successful treatment can be individually based on each case, including factors such as fracture pattern, bone quality, patient characteristics, and level of experience or familiarity of surgeons with operative technique.

Conclusion

Proximal humerus fractures are common with older patients and subsequently tend to necessitate minimally invasive treatment. Most of these injuries involve stable fracture patterns and can be treated without surgical intervention. However, in extremely displaced or unstable patterns, operative treatment should be considered. Because of the high rate of surgical complications, successful treatment can be individually based on each case, including factors such as fracture pattern, bone quality, patient characteristics, and level of experience or familiarity of surgeons with operative technique.

References

Survey of Current Articles Published on Total Ankle Arthroplasty and Ankle Fusion

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Abstract

In the United States, ankle fusion is more commonly performed than total ankle arthroplasty (TAA) for treatment of degenerative joint disease of the ankle. However, recent advances in implant design and technique have led to a renewed interest in research on TAA. To shed light on current research trends and limited data rather than examine the merits between both methods, we performed a PubMed search of studies on TAA and ankle fusion between January 1, 2009, and January 1, 2015, published in both the American edition of the Journal of Bone and Joint Surgery (JBJS) and Foot & Ankle International (FAI). We chose these journals because of their combined audience of both a specific orthopaedic subspecialty and the general orthopaedic community. A total of 132 articles met our inclusion criteria, with 76% and 3% of articles on TAA alone and ankle fusion alone published in JBJS, respectively, and 61% and 19% in FAI, respectively. Additionally, we found that a relatively small number of authors accounted for 65% of the articles in JBJS and 18% in FAI. The replacement of one procedure by the other will not likely occur in the near future, but our findings indicate a current research trend toward TAA more than ankle fusion. The clinical impact of an increased amount of studies on TAA has yet to be determined.

Introduction

In the United States, the gold standard for treatment of advanced ankle arthritis has been ankle fusion, performed more than six times as often as total ankle arthroplasty (TAA). Because first-generation TAA in the 1970s had high failure rates associated with inadequate fixation of implants and soft-tissue complications, the procedure was gradually discontinued.1 For the past several years, however, advances in surgical technique and implant design have resulted in an increased success of second-generation TAA in treating select patients with painful end-stage ankle arthritis. Although comparative long-term studies are still limited, interest has been renewed in TAA.2

We conducted a review of the number of articles on TAA compared with ankle fusion published in both the American edition of the Journal of Bone and Joint Surgery (JBJS) and Foot & Ankle International (FAI) from 2009 to 2015. We searched subtopics such as treatment outcomes, complications, gait analysis, and revision operations to examine possible trends in research. We also noted individual and groups of authors who reported most often on the topic.

Methods

The time period was arbitrarily set to include current and recent studies on newer-generation implants used by TAA and ankle fusion, revealing probable trends in direction of research. JBJS and FAI were chosen for article extraction because, combined, the journals targeted general orthopaedic audiences and the subspecialty of foot and ankle surgery. JBJS is available to all members of the American Academy of Orthopaedic Surgeons, which includes more than 30,000 members. FAI is distributed among more than 2100 members of the American Orthopaedic Foot and Ankle Society.

Articles on TAA and ankle fusion published in these journals from January 1, 2009, to January 1, 2015, were identified by searches of PubMed with Boolean modifiers of “ankle fusion,” "ankle arthrodesis,” “total ankle arthroplasty,” and “total ankle replacement.” Letters to the editor, commentaries, and author replies were not included. All articles were reviewed for inclusion by the first author and an independent review was done by the second. We selected articles that described outcomes, complications, gait analyses, and revision procedures. In addition, we tracked which group or set of authors published the most papers on these subjects in JBJS. We noted how often these authors and groups with multiple publications appeared in FAI.

Table 1. Combined amount of articles (132 total) on total ankle arthroplasty and ankle fusion published in Journal of Bone and Joint Surgery (29 total) and Foot & Ankle International (103 total) between 2009 and 2015 defined by inclusion criteria

<table>
<thead>
<tr>
<th>Topic</th>
<th>No. (%)</th>
<th>No. (%)</th>
<th>No. (%)</th>
</tr>
</thead>
<tbody>
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<td>TAA</td>
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<tr>
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<td>51 (38.64)</td>
<td>25 (19.20)</td>
<td>5 (3.79)</td>
</tr>
<tr>
<td>TAA to ankle fusion</td>
<td>1 (0.97)</td>
<td>1 (0.97)</td>
<td>1 (0.97)</td>
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<tr>
<td>Ankle fusion to TAA</td>
<td>2 (1.94)</td>
<td>1 (0.97)</td>
<td>1 (0.97)</td>
</tr>
</tbody>
</table>


1Includes two and four studies on cadavers and complications, respectively.

2Includes studies on technique.

Results

The primary search strategy for PubMed yielded 132 articles that met our inclusion criteria (Table 1). During the time period examined, a total of 29 studies on TAA and ankle fusion were published in JBJS. About 76%, 21%, and 3% of studies were on TAA alone, TAA and ankle fusion, and ankle fusion alone, respectively. In FAI, a total of 103 studies were included, with about 61%, 26%, and 19% on TAA alone, TAA and ankle fusion, and ankle fusion alone, respectively. In the JBJS articles, three multi-published authors or groups accounted for 65% of the articles. These three authors and groups accounted for 18% of the articles reviewed in FAI.

Conclusion

Although ankle fusion is more commonly performed for treating advanced ankle arthritis in the United States, the studies published on TAA alone in JBJS and FAI from 2009 to 2015 that met our inclusion criteria were greater in number. In JBJS, only one study3 on ankle fusion (vs 19 on TAA) described outcomes and complications, and only two articles compared treatment outcomes between the procedures. The total percentage of published articles only on TAA compared with ankle fusion in FAI (about 64% and 19%, respectively) was not as notable as in JBJS (about 76% and 3%, respectively), yet a considerable discrepancy still existed.

These findings may support a current research trend toward TAA more than ankle fusion. The results of our search also suggested that most available studies were performed by a relatively small group of authors. However, our study was limited to two peer-reviewed journals, albeit well-circulated and respected in orthopaedic subspecialty and general communities. These journals did not include studies from the field of podiatry in which TAA and ankle fusion are also prevalent topics.

Numerous reasons may explain the discrepancy between the percentage of TAA performed and the popularity of the topic in current research. We can only speculate on how these numbers affect surgeon and patient perceptions of TAA and ankle fusion. Additionally, we applaud the small group of authors who described most of the available research on these two procedures. Their findings and insights are essential in improving the success of treatment.

References

The Pediatric Orthopaedic Trauma Season: Does It Exist?

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Abstract

Background: It remains unclear whether pediatric trauma, including fracture, occurs more frequently at a certain time of the year. We developed a database based on the University of New Mexico orthopaedics consult log (OCL) with the aim of determining whether pediatric fractures have a seasonal predilection.

Methods: The OCL for 2009 and 2010, representing a total of 2,385 patient visits, was reviewed, and data on patients who were 17 years of age or younger who were treated for trauma were collected. The months and seasons of the year in which the trauma occurred were recorded.

Results: The OCL for 2009 and 2010 contained a total of 2,385 pediatric patient visits for trauma, including 1,479 visits (77%) for fracture. The number of fractures was substantially higher during July, August, September, and October compared with each of the other 8 months of the year. The percentage of total injuries that were fractures remained between 70% and 83% throughout the year. These data suggest that a fracture or trauma clearly occurs during the warmest months of the year in Albuquerque, when children are most likely to be on their summer vacation and participating in outdoor activities. In addition, the continuation of the fracture or trauma season into October may be related to the beginning of practice of school sports teams just before or at the start of the school year.

Introduction

Many pediatric orthopaedists think that children have more injuries during summer and school vacations, but this assumption may be based on anecdotal evidence. A few studies have documented certain trends in pediatric trauma. For example, Foltzan et al1 found that pediatric injuries occurred about twice as often in the summer as in other months of the year. A study by Lykissas et al2 showed an overall decrease in the incidence of pediatric injuries related to sports and recreation from 2000 to 2010, although the authors commented that such injuries may have increased in severity or been more frequently diagnosed in recent years, or that overuse injuries have become more common. Randsborg et al3,4 in a study including 1,403 pediatric fractures, calculated the overall annual incidence as 180 per 10,000 children younger than 16 and found that distal radius fracture was the most common fracture and that snowboarding had the highest activity-specific fracture rate. Sharma et al5 reported on epidemiologic aspects of injuries in 791 children under 12 years of age during a 1-year period. Injuries were much more common in boys than in girls, with a 2:1 ratio. Almost 60% of injuries were orthopaedic trauma. The most common cause of injury was a fall from height (40% of all injuries), and about 52% of injuries occurred at home. Swenson et al6 conducted an epidemiologic study of high school sports injuries reported by certified sports trainers in 2008 to 2011 and found that about 10% of injuries were fractures, with an overall rate of 1.82 fractures per 10,000 athlete exposures. Fracture rates were highest among football players, and the most commonly fractured body sites were the hand/finger (32%), lower leg (10%), and wrist (10%). About 17% of these fractures were treated surgically.

None of these previous studies specifically documented a trauma season for fractures. Therefore, in this study, we developed a database on pediatric fractures captured from the University of New Mexico (UNM) orthopaedics consult log (OCL) and then tracked the incidence of fractures according to month and season to determine whether fracture rates were higher during certain times of the year. Our hypothesis was that pediatric fractures would increase during summer.

Methods

The OCL for 2009 and 2010 included a total of 2,385 patient visits. When visits of patients who were older than 17 years of age were excluded, 1,479 visits remained in the study. The patients who made these visits were then categorized according to whether they had a fracture or non-fracture injury. The month and season during which each fracture occurred were recorded. The months of December, January, and February were considered winter; March, April, and May, spring; June, July, and August, summer; and September, October, and November, fall. Statistical analyses were then conducted to determine the combined number of fractures in 2009 and 2010 that occurred in each month of the year, the percentage of fractures according to season, and the percentage of total injuries that were and were not fractures according to month. All analyses used SAS software (SAS Institute, Cary, NC).

Results

Of the 1,479 pediatric visits for trauma recorded in the OCL for 2009 and 2010, 147 (77%) were for fracture (Table 1). The number of pediatric fractures was highest during August, September, July, and October, in that order (Figure 1). Substantially more fractures occurred during these months compared with each of the other 8 months of the 2 years studied. With respect to season, about 12% of all fractures occurred in winter, 15% in spring, 37% in summer, and 36% in fall (Figure 2). The difference between summer and fall was not significant. The percentage of total injuries in the OCL that were fractures remained between 70% and 83% throughout the year (Figure 3).

Discussion

Our analysis of the OCL indicated that children were considerably more likely to experience a fracture during the period from mid-summer to early fall than at other times of the year. These data suggest that a fracture or trauma season does exist, that it encompasses the transition from summer into fall, and that it lasts 4 months. The trauma season clearly occurs during the warmest months of the year in Albuquerque, when children are most likely to be on their summer vacation and participating in outdoor activities.
Motion-Tracking Drill System Using a Haptic Device for Evaluating and Training Motor Skills of Orthopaedic Resident Physicians Outside the Operating Room: A Pilot Study

Ashkan Pourkand, MS†; Christina Salas, PhD†; Deana M. Mercer, MD†; David I. Grow, PhD†

†UNM Department of Orthopaedics & Rehabilitation

Abstract

Background: Although experience within the operating room can help surgeons learn simple bone-drilling techniques, outside training may be better suited for complex procedures. We adapted a rotary handpiece with dual trigger and drilling attachments to a haptic device to train and evaluate motor skills of orthopaedic resident physicians outside of the operating room.

Methods: A total of 7 participants with varying levels of skill in orthopaedic surgery were asked to perform a task three times: drill a hole at 45° from the normal angle through both cortices of a synthetic diaphysis of a distal radius. Acceleration and acoustic data were collected using accelerometers, a microphone, and a data acquisition system. A total of 14 independent and dependent variables were measured and a correlation matrix was generated.

Results: A total of 24 statistically significant correlations related to bone drilling were found (P ≤ 0.10). Experienced participants pitched the drill forward, whereas inexperienced rotated the drill away from their body, resulting in a greater over-penetration distance. Conclusion: Users who pitch the drill forward may find the drill easier to control, and high-velocity drilling without bracing the elbow against the body may result in over-penetration of the bone. Results of a study with more participants can further specify differences in technique between surgeons of varying motor-skill levels, which may help develop more effective training programs outside of the operating room.

Introduction

Orthopaedics is a hands-on surgical specialty, requiring surgeons to possess adept motor skills. Historically, much of the technical learning has occurred in the operating room. This is an effective method of training in cases involving simple fractures or low technical rigor. However, for more complicated operative procedures and high-risk situations, an introduction to surgical techniques by immediate placement in the operating room may not be effective. We present preliminary data on a motion-tracking drill system for advanced surgical skills training outside of the operating room. This tool may be used in graduate medical education programs of orthopaedic surgery for training and evaluation of bone-drilling techniques.

Methods

A Stryker system 5 rotary handpiece with dual trigger and drilling attachments (Kalamazoo, MI) was adapted to a Phantom Omni haptic device (Sensable, Wilmington, MA) and additional sensors to measure tool position, acceleration, and acoustic data. Seven participants with varying levels of training in operative procedures were chosen, including a medical student, orthopaedic resident physicians, and orthopaedic attending physicians. Each participant was asked to drill a hole (at 45° from the normal angle) through both cortices of a synthetic diaphysis of a distal radius, while avoiding excessive penetration of the second cortex. This task was performed three times. Acceleration and acoustic data were collected at rates of 30 kHz using PCI-352CO accelerometers (Depew, NY), a GRAS 40PH microphone (Holte, Denmark) and a NI cDAQ-9184 data acquisition system (Austin, Texas). A total of 14 independent and dependent variables related to bone drilling, including spatial measurements (Figures 1A and 1B), were obtained. These included hole length; distance of over-penetration; diameter of the minor and major axes of the hole; margin of error in drilling the major axis of the hole; drill angle; minimum and maximum velocity of the drill, mean roll, pitch, and yaw angles of drill; and the surgical motion, and additional sensors to measure tool position, acceleration, and acoustic data. Seven participants with varying levels of training in operative procedures were chosen, including a medical student, orthopaedic resident physicians, and orthopaedic attending physicians. Each participant was asked to drill a hole (at 45° from the normal angle) through both cortices of a synthetic diaphysis of a distal radius, while avoiding excessive penetration of the second cortex. This task was performed three times. Acceleration and acoustic data were collected at rates of 30 kHz using PCI-352CO accelerometers (Depew, NY), a GRAS 40PH microphone (Holte, Denmark) and a NI cDAQ-9184 data acquisition system (Austin, Texas). A total of 14 independent and dependent variables related to bone drilling, including spatial measurements (Figures 1A and 1B), were obtained. These included hole length; distance of over-penetration; diameter of the minor and major axes of the hole; margin of error in drilling the major axis of the hole; drill angle; minimum and maximum velocity of the drill, mean roll, pitch, and yaw angles of drill; vibration in x- and y-define coordinates of the drill, and the surgical residency year of the participant. A correlation matrix for all variables was generated (Table 1), and a P value equal or less than 0.10 was considered to represent a significant correlation between groups.

References
Figure 1A. Roll, pitch, and yaw angles measured during drill training.

Figure 1B. Defined spatial parameters, including hole length; distance of over penetration; diameter of major axis of the hole; error in drilling major axis of the hole; diameter of minor axis of the hole; and drill angle.

Table 1. Correlation coefficients between each measured parameter related to bone drilling

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<th>Variable</th>
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<th>$v_{\text{min}}$</th>
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<td>0.114</td>
</tr>
<tr>
<td>$v_{\text{max}}$</td>
<td>0.301</td>
<td>1.000</td>
<td>-0.335</td>
<td>0.121</td>
<td>0.844</td>
<td>-0.321</td>
<td>-0.199</td>
<td>0.101</td>
<td>0.355</td>
<td>-0.219</td>
<td>0.114</td>
<td>0.036</td>
<td>0.308</td>
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<tr>
<td>$v_{\text{min}}$</td>
<td>-0.365</td>
<td>-0.335</td>
<td>1.000</td>
<td>-0.509</td>
<td>-0.356</td>
<td>0.596</td>
<td>0.602</td>
<td>-0.227</td>
<td>0.040</td>
<td>0.259</td>
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<td>-0.506</td>
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<tr>
<td>$L_1$</td>
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<td>0.121</td>
<td>-0.369</td>
<td>1.000</td>
<td>0.000</td>
<td>-0.097</td>
<td>-0.097</td>
<td>0.291</td>
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<td>0.086</td>
<td>-0.032</td>
<td>-0.030</td>
<td>0.007</td>
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<td>$L_2$</td>
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<td>0.864</td>
<td>-0.356</td>
<td>0.090</td>
<td>1.000</td>
<td>-0.280</td>
<td>-0.166</td>
<td>0.169</td>
<td>0.425</td>
<td>-0.312</td>
<td>0.242</td>
<td>0.127</td>
<td>0.065</td>
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<tr>
<td>$L_3$</td>
<td>-0.722</td>
<td>-0.221</td>
<td>0.596</td>
<td>-0.097</td>
<td>-0.200</td>
<td>1.000</td>
<td>0.992</td>
<td>-0.275</td>
<td>-0.129</td>
<td>0.495</td>
<td>-0.531</td>
<td>-0.530</td>
<td>0.191</td>
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<td>$L_4$</td>
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<td>-0.199</td>
<td>0.602</td>
<td>-0.071</td>
<td>-0.166</td>
<td>0.992</td>
<td>1.000</td>
<td>-0.231</td>
<td>-0.122</td>
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<td>-0.455</td>
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<td>0.187</td>
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<td>-0.275</td>
<td>-0.331</td>
<td>1.000</td>
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<td>0.535</td>
<td>0.040</td>
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<td>-0.129</td>
<td>-0.324</td>
<td>1.000</td>
<td>-0.602</td>
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<td>0.446</td>
<td>0.333</td>
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<td>-0.219</td>
<td>0.259</td>
<td>0.086</td>
<td>-0.312</td>
<td>0.465</td>
<td>0.426</td>
<td>-0.104</td>
<td>-0.602</td>
<td>1.000</td>
<td>-0.977</td>
<td>-0.568</td>
<td>0.026</td>
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<td>$\dot{y}$</td>
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<td>-0.307</td>
<td>0.032</td>
<td>0.242</td>
<td>-0.531</td>
<td>-0.435</td>
<td>0.202</td>
<td>0.417</td>
<td>-0.977</td>
<td>1.000</td>
<td>0.461</td>
<td>-0.116</td>
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<td>-0.108</td>
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<td>-0.370</td>
<td>-0.334</td>
<td>0.282</td>
<td>0.446</td>
<td>-0.508</td>
<td>0.461</td>
<td>1.000</td>
<td>0.143</td>
</tr>
<tr>
<td>std($\ddot{\theta}$)</td>
<td>-0.154</td>
<td>0.308</td>
<td>0.417</td>
<td>0.087</td>
<td>0.085</td>
<td>0.191</td>
<td>0.187</td>
<td>-0.053</td>
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<td>-0.116</td>
<td>0.143</td>
<td>1.000</td>
</tr>
<tr>
<td>y</td>
<td>-0.603</td>
<td>-0.336</td>
<td>0.340</td>
<td>0.114</td>
<td>-0.263</td>
<td>0.625</td>
<td>0.388</td>
<td>-0.168</td>
<td>-0.219</td>
<td>0.747</td>
<td>-0.793</td>
<td>-0.196</td>
<td>0.021</td>
</tr>
</tbody>
</table>

Table 3. Mean and standard deviation values for each variable related to bone drilling

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\theta_p$</td>
<td>0.30 (0.10)</td>
</tr>
<tr>
<td>$v_{\text{max}}$</td>
<td>0.70 (0.18)</td>
</tr>
<tr>
<td>$v_{\text{min}}$</td>
<td>0.36 (0.04)</td>
</tr>
<tr>
<td>$L_1$</td>
<td>0.55 (0.12)</td>
</tr>
<tr>
<td>$L_2$</td>
<td>0.49 (0.12)</td>
</tr>
<tr>
<td>$L_3$</td>
<td>0.65 (0.20)</td>
</tr>
<tr>
<td>$L_4$</td>
<td>0.30 (0.04)</td>
</tr>
</tbody>
</table>

Results

Mean and standard deviation values were calculated for each variable (Table 2). In total, 24 independent and statistically significant correlations ($P < 0.10$) were found (Table 3). These correlations indicated that experienced drill users pitch the drill forward, whereas inexperienced users had a tendency to overestimate the drill angle and subsequently externally rotated the drill away from their body. A greater over-penetration distance was found in participants who used a high maximum velocity with the drill or rolled the drill. Users who pitched the drill forward minimized roll and yaw angles of the drill, which helped avoid over-penetration of the bone.

Discussion

Although limited data were used for this analysis, key differences in drilling technique (depending on level of experience) were found among study participants. Users who pitch the drill forward may find the drill easier to control, although motion in other directions can be limited. Additionally, the practice of high-velocity drilling without bracing the elbow against the body can result in a tendency to plague the drill through the bone, thereby increasing the risk of damaging soft-tissue structures near the far cortex. Results of a study with more participants will further specify these differences in technique. Such findings may be used to evaluate the motor skills of resident physicians and individually customize their training experience.

Acknowledgments

This study was partially supported by donations from Stryker Corporation and Madison medical facilities. We also thank the University of New Mexico orthopedic resident physicians whose time and efforts made this research possible.
Removal of Partly Threaded Cannulated Screws After Treatment of Slipped Capital Femoral Epiphysis: A Pilot Study

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‡Department of Orthopaedics & Rehabilitation
§University of New Mexico

Abstract

Partly threaded cannulated screws (PTCS) are currently recommended for management of slipped capital femoral epiphysis (SCFE), but no advantage of these screws over fully threaded cannulated screws (FTCS) has been demonstrated. We investigated whether PTCS are more difficult to remove than FTCS.

Methods: The records of 33 patients who underwent implant removal after operative treatment of SCFE were reviewed, and the following data were collected: age and sex of the patient, type of screw used (partly or fully threaded), length of removal operation, and any comments on the difficulty of screw removal.

Results: Sixty-one percent of operative reports for patients in whom PTCS had been used mentioned difficulty in screw removal, compared with 10% of reports for patients given FTCS (P = 0.0094). Average time for removal of screws was 85 minutes for PTCS (n = 4) and 38 minutes for FTCS (n = 4) (P < 0.05). Conclusion: In this series, PTCS were more difficult to remove than FTCS, and removal took significantly longer.

Introduction

Slipped capital femoral epiphysis (SCFE) is a common hip disorder that affects adolescents. Management of this condition usually includes in situ fixation with screws, and the use of partly threaded cannulated screws (PTCS) has been described as the “gold standard” treatment. However, no definitive clinical data indicating that PTCS have an advantage over fully threaded cannulated screws (FTCS) with respect to fixation and outcomes have been reported. Some recent biomechanical studies in animals have shown no difference between PTCS and FTCS in fixation-failure rates. Other investigations have suggested that the larger number of threads provided by PTCS in the metaphyseal region may decrease the risk of femoral neck fractures.

ScFE, which currently has an incidence of 11 per 100,000 children, is the most common hip disorder affecting adolescents and is expected to become even more common because of the current obesity epidemic. Perventricular in situ fixation remains the mainstay of SCFE treatment, and most descriptions of surgical techniques for SCFE specifically mention use of PTCS for this purpose. Complications associated with SCFE include chondrolysis, labral tear, avascular necrosis, and femoroacetabular impingement, all of which can contribute to premature hip osteoarthritis.

Because of the increasing interest in hip preservation procedures, many adolescents and young adults with a history of SCFE treatment are now undergoing additional surgery with the goal of reducing the risk of early hip osteoarthritis. As our series shows, removal of retained screws is generally done during such procedures. Other reasons for screw removal include pain in the area around the screw head, greater trochanteric bursitis, and “prophylactic” removal in anticipation of future total hip arthroplasty because the difficulty of screw removal increases with the time after implantation.

Discussion

Table 1. Characteristics of patients who underwent retained removal of a partly threaded cannulated screw (PTCS) or a fully threaded cannulated screw (FTCS) after surgical treatment of slipped capital femoral epiphysis

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>PTCS</th>
<th>FTCS</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>15</td>
<td>12</td>
<td>0.12</td>
</tr>
<tr>
<td>Female</td>
<td>19</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Mean age, y</td>
<td>14.3</td>
<td>14.3</td>
<td>NS</td>
</tr>
<tr>
<td>Mean operative time for removal, min</td>
<td>85 (10-114)</td>
<td>38 (26-63)</td>
<td>&lt; 0.005</td>
</tr>
</tbody>
</table>

The numbers of such comments were recorded for each screw type.

The mean operating times required for removal of FTCS and PTCS were compared by using the Student t-test. The Fisher exact test was employed to compare the percentage of records in each screw group that contained comments on difficulty in removal. A P value of less than 0.05 was considered to represent a significant difference between groups.

The record review initially identified 33 patients with SCFE who underwent screw removal during the 8-year observation period. Four patients were excluded from the analysis of operating time because of missing data. We also excluded 21 patients who underwent a combined procedure (femoral neck osteoplasty or proximal femur osteotomy) because the time required for screw removal alone could not be ascertained.

Results

The mean operating time for removal of FTCS was more than twice as long as that for PTCS, although the difference was not statistically significant. PTCS removal took significantly longer than FTCS removal (mean, 85 minutes vs. 38 minutes; P < 0.05).

The complication rate for SCFE screw removal has ranged from 42% to 61%. Such rates are much higher than those for other pediatric implant removal procedures. Specific complications of screw removal include blood loss, proximal femoral fractures (both intraoperative and postoperative), wound infections and osteomyelitis, inability to remove the entire screw, prolonged operating time, and delayed recovery.

In our series, removal of FTCS was often described as extremely difficult. This is consistent with the results of the study by Pretell-Mazzini et al., who found that a longer threaded length of a SCFE screw was a significant “protective factor” against failure of removal. Screw-removal failure occurred in nearly 16% of their 38 cases, but there were no failures of removal of FTCS (P = 0.036). FTCS may be easier to remove because they maintain a thread track in the bone.
Our study was a pilot investigation with a small number of cases, but it highlights an important issue in pediatric orthopaedics: in patients who have been surgically treated for SCFE, PTCS may take longer to remove than FTCS and the PTCS removal procedure may entail a higher risk of removal failure and associated complications. For the past 10 years, we have elected to switch to use of FTCS in patients with SCFE, and this is reflected by the much shorter time from implantation to removal of FTCS compared with PTCS in our series. Although larger studies are needed to confirm the advantage of FTCS over PTCS with respect to ease of removal and other outcomes, we now recommend routine use of FTCS for in situ fixation in patients with SCFE, given the likelihood that these patients may require screw removal at some point in the future.

References

Third Extensor Compartment Disruption and the Biomechanics of Thumb Extension

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Abstract

Background: Procedures involving release of the third dorsal wrist compartment have been thought to transpose the extensor pollicis longus (EPL) tendon from its anatomical position. Few studies, however, have reported on the effects this might have on function and mechanics of the thumb. We analyzed the impacts of intact extensor retinaculum, release of the third dorsal compartment, and removal of Lister’s tubercle on thumb extension.

Methods: A total of 15 fresh-frozen cadaveric upper extremities (eight male, seven female; mean age, 52 years; range, 38-59 years) were used. For each specimen, three phases of testing were analyzed: the extensor retinaculum was intact, third dorsal compartment was released, and Lister’s tubercle was released. Force-displacement measurements were obtained to determine maximum extension and stiffness of the thumb by applying 1 N increments on the EPL until full extension of the thumb occurred. A one-way analysis of variance was used for statistical comparison.

Results: In 14 of 15 specimens, the EPL tendon transposed during the first trial after release of the extensor retinaculum. No significant difference in mean maximum extension or stiffness of the thumb was found (P = 0.45 and P = 0.74, respectively).

Conclusion: Functional loss of thumb extension may not occur with EPL transposition after release of the third dorsal compartment or removal of Lister’s tubercle. In patients with weakness in thumb extension, repairing the third dorsal compartment or creating a new pulley may not be effective.

Introduction

The extensor pollicis longus (EPL) is a muscle in the dorsal forearm and originates from the middle third of the ulna and dorsal aspect of the interosseous membrane. The EPL tendon functions as an extensor of the distal phalanx, contributing to extension of the proximal phalanx and first metacarpal. Additionally, its unique anatomical route allows for adduction at the thumb carpometacarpal (CMC) joint. Cadaveric studies have described EPL assistance in extension, adduction, and supination of the CMC joint. Notably, the EPL is the only extensor tendon that has an angular route from its origin to insertion. The tendon courses deep into the extensor digitorum communis, passing immediately ulnar to Lister’s tubercle (or dorsal tubercle of the radius) and angling obliquely toward the thumb to exit the third dorsal compartment of the wrist. The location of Lister’s tubercle can vary but serves as an important anatomical landmark in wrist examination and surgical treatment. Dorsal approaches to the wrist and operative procedures (eg, tenosynovectomy, prophylactic decompression, and disruption of Lister’s tubercle) by dorsal plating of distal radius fractures, wrist fusion, or bone-graft harvesting) have commonly involved release of the third dorsal compartment. However, little has been written about the possible effects of these techniques on subsequent thumb function. We separately evaluated the effects of a still-intact extensor retinaculum, followed by release of the third dorsal compartment, and followed by removal of Lister’s tubercle on EPL function as an extensor tendon. We hypothesized that releasing the normal anatomical manipulators of the route would decrease displacement of the EPL during extension of the thumb.
Methods
Fifteen fresh-frozen human cadaveric upper extremities (15 specimens) were studied. Eight specimens were male and seven female, aged an average of 52 years (range, 38-59 years). A custom aluminum fixture was created to secure each forearm for testing, with the ulnar side of the hand secured against the base plate and the wrist held in a neutral position. The fingers were positioned to allow for free range of motion and subsequent measurement of thumb extension in an axis perpendicular to the base plate (y-axis).

The specimens were kept frozen at -20°C and thawed to room temperature before testing. For each specimen, a longitudinal incision was made directly over the third dorsal compartment, extending 6 cm proximally. The incision continued down to the level of the extensor retinaculum that was carefully preserved. Braided polyester suture was secured proximal to the extensor retinaculum, using a locked Krackow suture technique, after which the specimen was mounted to the base plate. A mark was placed with indelible ink on the tip of the thumb, volar to the nail plate. The thumb was manually moved into flexion and extension positions to ensure smooth, uncrumbersomed motion. The suture attached to the EPL tendon was secured to a linear force transducer.

The specimens were first analyzed with an intact extensor retinaculum. In the second phase, the third dorsal compartment was released and the extensor retinaculum over the third dorsal extensor compartment was divided just ulnar to Lister’s tubercle. A small hemostat was placed into the fibro-osseous tunnel to protect the underlying EPL tendon, and the retinaculum was sharply incised using a scalpel. In varying amounts of synovial attachments were identified between the EPL and the sheath; however, these attachments were not released and we decided to observe any possible effect on our data collection. In the third phase, Lister’s tubercle was released using a small rongeur. The bony surface was made flat and contiguous with the dorsal surface of the distal radius. For each phase studied, the resting flexed position of the thumb in the y-axis was measured. Additionally, displacement of the tip of the thumb in the y-axis was measured, and this value was subtracted from the resting thumb position to determine incremental displacement. The force-displacement data were obtained by applying 1 N increments of tension on the EPL until full extension of the thumb was produced, defined as no displacement after three successive increases in force. This was repeated twice to obtain a total of three data sets for each specimen. The mean of the three data sets was used for comparison.

Outcome measures were the mean values of maximum extension and stiffness (force-displacement ratio at the most linear region of the curve) of the thumb. A graph was plotted that compared the averaged force-displacement data for each phase and a one-way analysis of variance was used for statistical comparison of results.

Results
Mean (SD) values were obtained during each phase. Extension of the thumb was 63.20 mm (20.96 mm) with an intact extensor retinaculum; 70.53 mm (19.58 mm) after release of the third dorsal compartment; and 72.33 mm (19.65 mm) after removal of Lister’s tubercle. In the same order, stiffness was 0.07 N/mm (0.03 N/mm), 0.06 N/mm (0.02 N/mm), and 0.06 N/mm (0.02 N/mm). No significant difference in mean maximum extension or stiffness of the thumb was found between the three phases (P = 0.45 and P = 0.74, respectively). A representative force-displacement plot of thumb extension for each testing phase is shown in Figure 1.

Figure 1. Representative force-displacement plot shows results with intact extensor retinaculum (ER, blue), followed by ER release (red), and followed by Lister’s tubercle release (green).

Synovial attachments were often observed between the EPL tendon and its fibro-osseous sheath. The degree of synovial attachment varied among specimens. After release of the third dorsal compartment, tension was seen in these attachments as increasing force was applied. The attachments ruptured at relatively low force (0-3 N) in most specimens but were sometimes found to effectively tether the EPL within the sheath at considerably higher force (5-7 N or 12-13 N). When these synovial bands ruptured, the EPL would transpose from its anatomical position, ulnar to Lister’s tubercle, to a position dorsal and radial to the tubercle. In 14 of 15 specimens, the EPL tendon transposed during the first trial after release of the extensor retinaculum. In one specimen, the EPL maintained its position ulnar to Lister’s tubercle during all three trials after release of the third dorsal compartment. In this case, the tendon did transverse (0.3 mm or 20% of the tubercle’s thickness at the application of 10 N of tensile force, with notable synovial attachments observed. Once the tendons transposed, no reduction (ulnar to Lister’s tubercle) was noted, even at rest and low tensile force in the second and third trials.

Discussion
The complex motion ascribed to the EPL tendon could be disrupted with release of its constraints around Lister’s tubercle. Findings from studies have indicated that transposition of the EPL tendon decreases the arm adduction moment of the EPL at the CMC joint. A study on extensor indicis proprius (EIP) to EPL transfer described similar cadaveric results but focused only at adduction of the CMC joint. No biomechanical studies have detailed the effect of releasing specific constraints on the EPL tendon.

The findings of the current study suggest that no functional loss of thumb extension occurs with EPL transposition after release of the third dorsal compartment or removal of Lister’s tubercle. Contrarily, we observed an increase in thumb extension at comparable force after EPL transposition. The reason may be related to a decrease in friction on the EPL tendon when displaced from its position ulnar to Lister’s tubercle.

Conclusively, the etiology of spontaneous EPL tendon rupture, Kutsumi et al studied the gliding resistance or friction experienced by the EPL tendon within the third dorsal compartment. Cadaveric specimens were used to evaluate the differences (which were significant) between measured gliding resistance of the EPL tendon and the extensor digitorum communis II tendon within their respective extensor compartments. Changes in wrist flexion, extension, and radial and ulnar deviation affected the amount of friction or gliding resistance measured.

Additionally, a more straight-line pull between the muscle origin and tendinous insertion may allow improved muscle function. Shah et al examined the change in resting muscle fiber length of the EPL after transposition, with a mean proximal tendon migration of 3.0 mm and EPL resting fiber length of 5.7 cm. The likely effect of this change in fiber length would be considered minimal.

Repairing the third dorsal compartment after its release has been reported, and one study described re-creation of the moment arm of the third dorsal compartment when Lister’s tubercle is removed by an EIP to EPL transfer. In a subcutaneous transfer. In a discussion of EPL tendon release for treating tenosynovitis, Huang and Strauch advocated the technique described by Froimson, which involved a complete release of the EPL from third compartment and transposition into the subcutaneous tissues. The authors cited their extensive experience with translocation of the EPL tendon in this manner and reported no problems with compromise of EPL function.

Our study suggests that, after transposition of the EPL, it would be unlikely for the tendon to slip into anatomical location and function in original position. Once transposed, the tendons did not displace to their original position ulnar to Lister’s tubercle, even at rest and at low force in subsequent trials. This is an in vitro study, however, with limitations. Clinical correlations need to be made carefully, and in a clinical situation, the wrist will likely not be secured in a neutral position and soft-tissue healing and scarring will occur. Additionally, 1 N incremental force was applied to the EPL for all loading conditions. There is no indication that, on release of the EPL from the third dorsal compartment or from Lister’s tubercle, the muscle would be able to apply the same level of force without these pulleys intact. Thumb extension may be limited by the inability for the muscle to produce this force.

We did find that less force was required for thumb extension after third dorsal compartment release and after removal of Lister’s tubercle. In patients with otherwise normal hand function, this may have little effect in clinical decision making. But, in patients who already have conditions resulting in weakness of thumb extension, these findings may be useful. Efforts to preserve thumb extension by repairing the third dorsal compartment or creating a new pulley may not be necessary. However, one might consider whether an imbalance can be created in patients with intrinsic or flexor weakness, metacarpophalangeal, or other joint instabilities. The loss of the EPL as an extrinsic thumb adductor should be considered in patients with loss of intrinsic thumb adduction.

References
Nonunion After Hybrid Plating with Locking and Nonlocking Screws in Radius and Ulna Shaft Fractures: Report of Two Cases

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Abstract

Conventional compression plating has been found effective in treating forearm diaphyseal fractures, providing stability as well as resistance to axial, torsional, and bending forces. Locked plating has provided stability without frictional force between the bone-plate interface, which may help preserve periosteal blood supply, and is useful in treating metaphyseal, comminuted, and osteoporotic fractures. Hybrid plating has been used in an attempt to combine the strengths of these two techniques; however, in the context of simple forearm diaphyseal fractures with healthy bone, its effectiveness is only theoretical. We describe two patients in whom open reduction and internal fixation with hybrid plating to treat radius and ulna diaphyseal fractures resulted in nonunion. We performed a revision procedure using conventional compression plating and achieved full healing with complete union in both cases. These findings suggest that hybrid fixation for treating such fractures may not lead to better outcomes than conventional plating.

Introduction

The popularity of locked plating has increased relative to conventional nonlocked plating for treating various fractures. The two plate types have different benefits; conventional plates provide absolute stability and primary bone healing, whereas locked plates provide relative stability and secondary bone healing. These benefits are related to the differing biomechanics of the plating systems.

Conventional plating achieves dynamic axial compression by means of eccentric placement of screws in the oblique screw holes, which provides absolute stability. Compression of anatomically aligned fragments results in friction, allowing resistance to axial, torsional, and bending loads. The concept of leaving no gap between bone and plate to provide compression relies on the frictional force created by the screws. However, nonlocking screws can provide very limited purchase in thin cortex or osteoporotic bone. Because the screws do not lock to the plates, the plates provide no control over which direction the screws will orient when force is applied, which can lead to weakening of the bone surrounding the screw during healing with loosening of the screw-to-bone interface (also known as screw toggle or cut-out). Therefore, nonlocked plating may not be successful in weak or pathologic bone, and the loss of absolute stability can lead to nonunion.

Locked plating relies on a stable angular construct between the screws and plate and is useful in treating metaphyseal, comminuted, and osteoporotic fractures. This technique uses threaded screws that thread directly into the plate and underlying bone, which eliminates screw toggle within the plate when loaded during healing. Subsequently, this plate design acts as an “internal external fixator.” The plate is not compressed against the bone cortex but can be positioned to allow maintenance of the periosteum and external blood supply to the bone cortex. On the other hand, locked plates do not offer any significant advantage over nonlocked plating techniques in treating diaphyseal fractures in bones of normal density.

Hybrid fixation (combining locking an nonlocking screws), has been developed and promoted as having the benefits of both techniques. After anatomical reduction, the plate is fixed to bone with nonlocking screws, with use of locking screws to prevent screw toggle and loosening of load during healing. We present two cases in which open reduction and internal fixation (ORIF) with hybrid plating to treat concomitant radius and ulna diaphyseal fractures led to nonunion, which was successfully salvaged by revision procedures with conventional plating.
Case Report

Case 1

A 19-year-old male baseball player sustained a left radius ulna shaft fracture but was otherwise healthy. At another facility, he underwent hybrid ORIF at another facility, in which there was a delayed radiographic union. About 18 months postoperatively, the patient fell while playing volleyball. Radiographs showed a right radius and ulna nonunion with a break of the radial plate at the site of the previous fracture (Figure 2A). The patient also had partial palsy of the posterior interosseous nerve. During the revision operation, a hypertrophic nonunion of the ulna and an atrophic nonunion of the radius, with a break of the radius shaft plate, was confirmed.

We performed revision ORIF with removal of all previously placed screws and plates. Low-contact dynamic compression plates with nonlocking, small-fragment, hex-head screws (3.5 mm) were implanted. A compression and lag technique and local bone grafts were used. By 1 month postoperatively, nearly complete healing had occurred (Figure 1B). Eight weeks later, the patient resumed playing baseball. After an additional 8 months, the ulnar implant was removed because of prominence of the ulna plate. The patient had no additional problems and returned to playing collegiate baseball.

Case 2

A 24-year-old healthy man sustained fractures of his right radius and ulna shafts during work, with minimal comminution. He underwent hybrid ORIF at another facility, in which there was a delayed radiographic union. By 6 months, the patient had complete radiographic and clinical union. The use of standard nonlocking plates may be more effective in achieving successful healing rates.

Both implants were removed, and revision ORIF of the right radius and ulna nonunion was performed with use of local bone grafts. Periarticular nonlocking plates were implanted, and compression fixation was established by using standard nonlocking screws (Figure 2B). At 3 months postoperatively, no pain or infection was present and healing to near union had occurred. By 6 months, the patient had complete radiographic and clinical union.

Discussion

The traditional treatment of diaphyseal forearm fractures has involved use of conventional nonlocking compression plates.1 In light of newer technology and the increasing success of hybrid plating in osteoporotic and comminuted fractures, some surgeons have attempted to use hybrid plating on diaphyseal forearm fractures with normal bone quality.

Hybrid plating may be appropriate for osteoporotic bone and other anatomical locations, but the procedure does not appear to be optimal for the indications used here. Based on our experience, we do not recommend locked or hybrid fixation of radius and ulna shaft fractures in healthy individuals. The use of standard nonlocking plates may be more effective in achieving successful healing rates.

References

Isolated Traumatic Subscapularis Tear in a 12-Year-Old Male Gymnast: A Case Report

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Abstract
Isolated avulsion fractures of the lesser tuberosity are rarely encountered in younger and older populations. However, because the tendon of the subscapularis insertion is stronger in skeletally immature individuals, isolated tears to the tendon occur more commonly in adults than children and adolescents. Most studies have been limited to case reports that mainly describe traumatic subscapularis tears in adolescent athlete-patients. We present a 12-year-old male gymnast who reported to our clinic with pain and weakness in the right shoulder at 2 months after the initial injury. We performed open repair with suture anchor fixation for treatment of an isolated subscapularis tear. At 6 months postoperatively, the patient felt no pain, regained full range of motion and strength, and returned to highly competitive physical activity.

Introduction
Isolated avulsion fractures of the lesser tuberosity of the proximal humerus are uncommon injuries, especially in children and adolescents. Although a study by Harrigan in 1895 was the first to describe a lesser tuberosity avulsion fracture in an adolescent boy, both an isolated and pediatric occurrence of this fracture was not reported until nearly a century later. These isolated avulsion fractures are unusual in skeletally immature patients because, at younger ages, the tendon of the subscapularis insertion is stronger than the tuberosity. In contrast, older individuals (>40 years) have reduced mechanical properties of the rotator cuff, allowing injuries to the tendon to occur more frequently with avulsions. Because of its infrequency, isolated tears of the subscapularis tendon in young patients have been examined mostly in case reports of adolescent athletes. The subscapularis muscle relaxes when the arm is in 90° of abduction, but forceful external rotation of the arm will cause the muscle to eccentrically contract. These injuries are typically related to rotator cuff tears resulting from traumatic events such as forced abduction and external rotation. Associated injuries include biceps tendon tears, biceps tendon dislocation, and anterior dislocation of the glenohumeral joint. However, only 2% to 7% of rotator cuff tears (found in <1% of patients aged >20 years) involve subscapularis tears. The results from physical examinations are often limited owing to the rarity of this condition, which subsequently can delay accurate diagnosis. We describe thorough examination and successful treatment of an isolated subscapularis tendon tear without bony avulsion in an adolescent gymnast.

Case Report
A 12-year-old male gymnast presented to our clinic with anterior pain and sensation of weakness in the right shoulder. The patient participated in highly competitive gymnastics and was jumping on a trampoline when the injury occurred. He had performed a front flip, missed his landing because of over rotation, and placed his arm in front to brace the fall and protect his face. On evaluation immediately after the injury, no glenohumeral dislocation was noted, but the patient did express paresthesias (which resolved a few days later) and pain. He was referred to our clinic by an orthopedist from another facility and arrived 2 months after the initial injury. No symptoms of glenohumeral instability were found, and the patient did not report previous injuries to the shoulder. On physical examination, he appeared generally healthy and physically fit. Examination of his right upper extremity revealed tenderness to palpation at the anterior shoulder. Results of belly-press and lift-off tests were positive for damage to the subscapularis insertion. Additionally, the patient had increased external rotation of the right shoulder compared to the contralateral, uninjured side. About 80% of overall shoulder strength was present when testing the subscapularis muscle by means of resisted internal rotation, and the shoulder was neurovascuclarly intact distally. Findings of magnetic resonance imaging (MRI) revealed a full-thickness tear of the retracted subscapularis tendon, with mild damage to the anterior labrum but no evidence of a Hill-Sachs lesion (Figure 1).

After talking with the patient and his parents, we decided to perform open repair of the subscapularis tendon in the right shoulder by the deltopectoral approach. Results of initial intraoperative examination under anesthesia revealed a globally stable glenohumeral joint. The subscapularis tendon was found retracted to the level of the glenoid. A small amount of cartilage with the detached tendon was noted, but no bone was avulsed from the humerus. Three PEEK fully threaded, triple-loaded 5.5 mm suture anchors were used to fixate the subscapula to the glenoid. The subscapularis tendon was found to be global in nature, and the repair was performed using a Mason-Allen stitch configuration, and sutures were tied down sequentially while the shoulder was in neutral rotation.

Postoperatively, the shoulder was placed in a sling for 6 weeks. At 2-week follow-up after surgery, the strength of the shoulder was tested by pendulum exercises, rotation from external to neutral position, and wall-crawl activities. At 6 weeks postoperatively, results of a belly-press test were negative for tears to the subscapularis tendon, and the right shoulder had full range of motion equal to the contralateral side. The patient enrolled in physical therapy and used resistance bands to strengthen the rotator cuff. At 12 weeks postoperatively, the patient noted baseline shoulder strength, finished formal physical therapy, and began home-based exercises with a resistance band. The range of motion of both shoulders was equal and the subscapularis insertion had 100% of strength. Additionally, results of belly-press and lift-off tests were negative for subscapularis tendon tears. Although limited to about 70% of full exertional capacity without impact activity, the patient returned to gymnastics. At 6 months postoperatively, he fully returned to competitive gymnastics (Figure 3).
belly-press, and bear-hug tests.3,4,8 In our case, an increase in passive external rotation of the right shoulder compared to the contralateral side was frequently noted. These results from physical examination should encourage preoperative imaging such as radiography and MRI to confirm diagnosis.9 Although not always described with success, axillary views of radiographs may show avulsions of the lesser tuberosity.10-12 Radiographs of subscapularis tears obtained shortly after initial diagnosis can reveal calcification at the level of the retracted tendon as a result of the robust healing response in children.4

Open procedures with the deltopectoral approach using transosseous sutures or suture anchors are the standard treatment for full-thickness tears.3,4,9 Coates and Brendahl3 advocated arthroscopy as a diagnostic adjunct to address intraarticular results of pathological studies, including labral tears of the shoulder. A study by Bartl et al13 described significant improvement in postoperative constant scores and follow-up examinations for 30 patients with traumatic isolated subscapularis tears treated with open repair by the deltopectoral approach using suture anchors. Caniggia et al14 recommended close monitoring of the patient postoperatively for malunion, impingement, instability, weakness, chronic pain, fracture displacement, and biceps tendon dislocation from the bicipital groove. However, no standard recommendation exists on how to treat partial-thickness tears of the rotator cuff in children.4

Other studies have noted poor outcomes with nonoperative treatment in adolescents and children.3,6,7 Our case reinforces these findings and describes successful operative treatment of an isolated subscapularis tear with suture anchor fixation in a child. Thorough physical examinations and preoperative imaging may be crucial in properly diagnosing a tear of the subscapularis tendon, allowing for successful treatment.

References

Severe Ischemia of the Finger After Use of Compressive Self-Adherent Wrap: Report of Two Cases

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Abstract

Use of Coban compressive self-adherent wraps (3M, St Paul, MN) has been found helpful in treating various conditions and injuries of the extremities, including lymphedema, edema in burned hands, and sprains or strains. However, the availability and easy application of the wrap have resulted in its common usage with or without adequate instructions. We report two cases in which severe pain and ischemia developed after this bandage was circumferentially applied to a finger to stop bleeding from a simple laceration. One patient required amputation at the level of the proximal interphalangeal joint; the other had resolution of venous congestion symptoms after removal of the nail plate, administration of aspirin, and use of a heat lamp to facilitate vasodilation and increase blood flow. Although the wrap can be safely used when employed correctly, physicians and consumers should be aware that its misuse can have severely adverse effects.

Introduction

A Coban compressive wrap that sticks only to itself and consists of a latex-based laminate of a non-woven substance and elastic fibers (3M, St Paul, MN) has been found helpful in treating chronic venous stasis ulcers of the leg and lymphedema of the extremities.4 Additionally, the light weight, self-adherence, resistance to slipping, and sustained compression of the wrap have resulted in its non-stick nature and easy application have resulted in common usage by both health care professionals and consumers, with or without clinician instructions. Although the product is safe when used correctly, wrapping it too tightly and leaving it in place for an extended period can have adverse effects. We describe two patients in whom a severe tissue necrosis occurred in a finger after the wrap was used incorrectly.

Case Reports

Case 1

A 24-year-old male prisoner presented to our clinic with severe pain and ischemia of the middle finger of his left hand (Figures 1A and 1B). Revascularization was not possible, and the distal aspect of his finger was ischemic and had sensory deficits to light touch and pinprick. He had sustained a laceration just proximal to the nail, and the wound was sutured and subsequently covered with a compressive Coban wrap in the medical facility of the prison. The wrap remained in place for several days, although the patient said he had severe pain because of the tight dressing. When the bandage was removed, ischemic changes over the distal phalanx of the finger were observed and the patient was referred to our institution.

Results of a physical examination suggested that the middle phalanx was the most distal level of the finger that was functionally viable, and the patient requested immediate amputation at that level. Intraoperatively, however, the middle phalanx was found to be necrotic, so amputation was performed at the level of the proximal interphalangeal joint.

Postoperatively, the patient initially had 1 cm² of eschar spread distally on the wound, which healed after daily dressing changes. He also had some hypersensitivity of the stump, which resolved after administering a course of gabapentin. At 4 months postoperatively, the amputation site was well healed, although with prominent scarring; the stump had good vascularization, and no hypertension was observed. The patient had full ROM of the metacarpophalangeal joint.

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Case Report
A 3-year-old girl presented to our clinic with pain and swelling in the little finger of her left hand. While clipping the fingernails of the child, the grandmother had accidentally cut the finger. A compressive wrap was applied first to the base and then rest of the finger to stop the bleeding. Two days later, the patient complained of pain in the finger and her mother removed the wrap. The finger appeared swollen and purple, and subsequently the patient was brought to the emergency department.

On physical examination, her little finger was swollen and discolored from just distal to the metacarpophalangeal crease. A blister of 1 cm in diameter was observed over the ulnar aspect and black eschar at the level of the proximal phalanx (Figure 3). Additionally, the patient could not fully extend her finger because of a flexion contracture of about 45° at the proximal interphalangeal joint. She was referred to occupational therapy for scar therapy and ROM exercises.

Discussion

Use of a compressive self-adhesive Coban wrap can be helpful in treating various injuries and conditions of the extremities, but it does have some disadvantages associated with ROM impairment. Glassy and Phillips found that healthy volunteers whose fingers were wrapped with the material had a decrease in ROM of all joints. The authors also noted that, because maintenance of ROM may decrease edema, use of the wrap could impede resolution of edema symptoms. A cadaveric study by Buonocore et al reported that the common practice of applying the wrap immediately after flexor tendon repair to mitigate swelling may increase the stress placed on tendons during early ROM therapy aimed at reducing stiffness. This effect was in addition to the already-increased work of flexion caused by the edema, and the combination of both may result in rupture of the tendon repair.

To our knowledge, the current cases represent the first published reports of a severe tourniquet effect of the compressive wrap, although the Manufacturer and User Facility Device Experience database of the US Food and Drug Administration contains two similar cases. One case described a patient who used several layers of the material to dress a leg ulcer, after which gangrene of the lower limb developed that necessitated amputation. In the other case, amputation of the distal portion of the right index finger was necessary because of circulation impairment after the wrap had been in place for 4 days.

Safe use of the compressive wrap involves avoidance of stretching the material during application. This can be avoided by removing the bandage completely from the roll before applying it, overlapping the previous layer by 50%, and gently compressing the dressing at its end to achieve self-adherence. In a study on burned hands with skin grafts, Lowell et al advised carefully applying any elastic material because the amount of pressure increased in a linear fashion with each new layer. The authors recommended wrapping in a spiral fashion, distally to proximally or in a figure-of-eight configuration, to reduce the risk of a tourniquet effect. Additionally, the wrapped limb or finger should be closely monitored for onset of discoloration or inflammation.

Such detailed instructions and cautions for use of the Coban wrap are not included on every packaged product. Subsequently, the bandage may be applied by individuals who have not read or understood the instructions. Severe adverse effects that may necessitate amputation, although not often reported, are possible. We recommend extreme caution when using Coban wrap to treat children and other patients who cannot adequately verbalize concerns of discomfort or pain, as in the two current cases.

References

Carpal Tunnel Syndrome Associated with a Palmaris Profundus Tendon: A Case Report

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Abstract

Carpal tunnel syndrome (CTS) is often found in adults and may be associated with rare anatomical abnormalities in the hand, such as the presence of a palmaris profundus tendon. Although the muscle was originally thought to be a variant of the palmaris longus muscle, some case studies have described both structures during operative treatment with open carpal tunnel release. We present a case of a 51-year-old woman who underwent open carpal tunnel release to treat CTS of the right hand. Preoperatively, results of electrodiagnostic tests and clinical examinations, respectively, were normal and equivocal. Intraoperatively, a palmaris profundus tendon was found compressing the median nerve and the patient had a palmaris longus tendon in the wrist. At 6-week follow-up, no recurrence of symptoms was reported. Abnormal nerve structures, although rarely encountered, should be considered in diagnosing CTS of the hand. Resection of the palmaris profundus tendon may help avoid possible recurrence of symptoms.

Introduction

Carpal tunnel syndrome (CTS) is the most common cause of nerve entrapment in adults.1 The diagnosis, initially based on the evaluation of symptoms and results of physical examination, can be confirmed by positive findings from electrodiagnostic studies.2 A thick transverse carpal ligament, fibrosis around the median nerve, and persistent median artery are the most common findings encountered during operative treatment with open carpal tunnel release. Other factors may result in compression of the median nerve within the carpal tunnel, including anatomical variations of the nerve and other tendinomuscular synovitis, lipomas, and the presence of a lumbrical muscle.3,4

The presence of a palmaris profundus muscle is one such variant. It is very rare and was first described in 1908 as a “musculus palmaris profundus” by Frohse and Fränkel.1,5 The incidence is currently unknown, but a cadaveric study on upper-extremity specimens reported this abnormality in 1 of 530 arms.6,6 It has been found to arise from the radial volar forearm, common flexor mass, flexor pollicis longus muscle, and palmar fascia.7 The tendon enters the carpal tunnel superficial to the median nerve to insert on the deep aspect of the palmar aponeurosis. We describe a patient in whom a palmaris profundus tendon was encountered during open carpal tunnel release, and the tendon was considered to be the cause of median nerve compression. The patient recovered uneventfully.

Case Report

A 51-year-old, right-handed woman presented to our clinic with numbness in both hands, which had been ongoing for the past several years. She was generally healthy with multiple well-controlled chronic medical conditions, including Hashimoto thyroiditis and possible Sjögren syndrome. No signs of atrophy of the thenar muscles were noted, and the results of Phalen, thumb compression, and Tinel tests were equivocal.

Nerve conduction studies on the right hand were done in October 2013 and January 2014 at two different institutions. In October 2013, she had motor and sensory latencies of 3.5 ms and 3.1 ms, respectively, and in January 2014, motor and sensory latencies were, respectively, 4.0 ms and 2.6 ms. Results of both electromyography studies were interpreted as indicating mild CTS. Additionally, the findings from a neurosurgical evaluation in October 2013 indicated no abnormalities of the cervical spine.

Because the symptoms persisted, the patient underwent open carpal tunnel release for treatment of CTS after adequate counseling. Upon release of the transverse carpal ligament and examination of the nerve, a palmaris profundus tendon was found and appeared to overlie the median nerve and recurrent motor branch (Figure 1). The tendon was carefully released from the median nerve and excised. No attempt was made to follow the tendon into the forearm.

Postoperatively, the patient was given a soft dressing and instructed to use her hand for light activities. At 2-week follow-up, she reported complete resolution of her numbness and tingling. At 6 weeks postoperatively, the patient noted some weakness in the thumb and index fingers during jaw-pinch exercises but resolution of symptoms. She was released from follow-up on an as-needed basis.

Discussion

A PubMed search using terms such as “carpal tunnel syndrome” and “palmaris profundus” revealed seven reports on palmaris profundus tendon in patients aged 19 years to 70 years, with most patients being women.4,6,8 Diagnoses were typically made based on clinical symptoms and results of physical examination. In five of these case reports, the findings from electrodiagnostic studies were positive.1,2,4,7,8 Additionally, two reports described the presence of palmaris profundus tendon.1,2

Good treatment outcomes after resecting the palmaris profundus tendon have been reported. Jones1 noted that, in a patient with recurring symptoms, a palmaris profundus tendon was found during reoperation and resected. Postoperatively, the patient had complete relief of symptoms. A study by McClelland and Means4 reported the presence of a bifid median nerve, persistent median artery, and palmaris profundus tendon attaching proximally to the deep surface of the transverse carpal ligament.

Reports have also noted abnormal proximal take off of a lumbrical muscle and synovitis.5 Some studies have mentioned the absence of palmaris longus muscles if the palmaris profundus is present,4,4 and most report abnormal findings from electrodiagnostic studies or clinical examinations.1,2,4,7,8 However, in our case, a palmaris longus tendon was located and negative results from clinical examinations and electrodiagnostic studies were observed. We advise careful evaluation in detecting any abnormalities within the carpal tunnel. If a palmaris profundus tendon is found, it should be resected to avoid recurrence of symptoms. In 40 years of hand surgery practice, the senior author has encountered a similar case only once before.

References

Surgical Treatment of Chronic Dislocation of a Posterior Tibial Tendon in a Collegiate Athlete: A Case Report

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Abstract

Traumatic dislocation of the posterior talibial tendon (PTT) is a rare and often misdiagnosed injury. The limited number of cases, ambiguous results of initial imaging studies, and presence of symptoms similar to medial ankle sprains can contribute to unsuccessful long-term treatment. Current studies, although limited, report high rates of failure in nonoperative compared with operative treatment. We describe a 21-year-old male baseball player who experienced pain and mild swelling in his ankle after falling while running at full speed. After 5 months of continuous pain in the medial ankle, the patient was referred to our clinic and underwent suture anchor repair for treatment of PTT dislocation. At about 4 months postoperatively, no recurrence of symptoms was noted.

Introduction

Traumatic dislocations of the posterior talibial tendon (PTT) are difficult to diagnose. Initial radiographs and symptoms are often misleading, showing no signs of dislocation and mimicking medial ankle sprains, respectively. Results of magnetic resonance imaging (MRI) can also be difficult to interpret because of tendon subluxation and dislocation with certain motions and return to anatomical location with others. Evaluation of patient injury history and results of physical examinations remain the most reliable diagnostic tools. Fewer than 65 cases of traumatic PTT dislocations have been reported. The injury has been mainly associated with strenuous physical activity such as waterskiing, rock climbing, and snowboarding. The mechanism of injury typically involves inversion of the foot with dorsiflexion or plantar flexion after a sudden, forceful contrac tion of the PTT. At the time of operation, findings can include a hypoplastic retromalleolar groove, rupture of the flexor retinaculum, or an elevation of the peroneal attachment of the retinaculum. We present one case of PTT in which repair of the retinaculum using three suture anchors led to resolution of symptoms in short-term follow-up.

Case Report

A 21-year-old male collegiate baseball player was referred to our clinic after 5 months of continuous pain in the medial side of the ankle. He had injured his ankle after running at full speed and tripping on an uneven surface. The patient described feeling a twisting of the ankle. He initially had difficulty bearing weight, prompting an evaluation by the training staff of his team. Medial ankle tenderness with mild swelling and ecchymosis was reported, and the condition was diagnosed as a medial ankle sprain and treated conservatively with rest, ice, and elevation. After noting improvement in ankle pain, the patient resumed static training such as parallel squats and leg press. However, pain and instability in the medial side of the ankle were felt when he attempted more dynamic exercises such as pivoting and cutting. Because radiographs had not revealed a fracture, it appeared that the symptoms were related to sequela of an ankle sprain. Treatment included nonweight bearing in a cast boot followed by several weeks of protected gradual weight bearing. The patient was able to perform static exercises at a high level but continued to experience pain with dynamic activity. This worsened into difficulty with straight-line running and ascending and descending stairs. At this time, he reported that most of his swelling had resolved, and he noticed a mobile bulge in the area of the medial malleolus with plantar flexion and internal rotation of the ankle. Almost 4 months after the initial injury, the patient was still unable to participate in athletic activities. He was subsequently referred to our orthopedic clinic for evaluation by a foot and ankle specialist.

On physical examination, no gross deformity was appreciated. Ecchymosis was not noted, and only a slight amount of swelling of the medial side compared the lateral and contralateral sides of the ankle was noted. The patient felt no tenderness to palpation of the foot, and the ankle had equal range of motion (passively and actively) to the contralateral side. The strength of the foot and ankle was also normal. However, it was observed that plantar flexion and internal rotation reproduced the described bulge which appeared to be a PTT dislocation (Figure 1). The tendon could be returned to its origin both by direct manipulation and when the foot resumed a neutral position. Weight-bearing radiographs of both feet did not reveal any fracture or deformity. An MRI image was obtained to further examine the soft-tissue surrounding the ankle. The results showed the PTT in the retromalleolar groove with a slight tear in the retinaculum, which was felt to allow for medial subluxation (Figure 2). Morphological features of the retromalleolar groove were similar to those found in an uninjured ankle (Figures 3A and 3B). Operative and nonoperative techniques were discussed with the patient. Because of his desire to return to collegiate athletics, the failure of conservative treatment to this point, and the small amount of data that suggested improved results of surgical compared with conservative treatment of PTT dislocations, he elected to undergo surgical intervention.

Postoperatively, the foot of the patient was placed into a nonweight-bearing plaster splint. His sutures were removed at the 2-week postoperative visit. At 3 weeks postoperative, the range of motion of the ankle was normal, with no signs of tendon dislocation or subluxation. The patient was placed into a walking boot and progressive weight bearing began. The use of the boot was discontinued at 2 months postoperatively, and the patient was transitioned into ankle bracing only. At 3 months postoperatively, gradual exercise...
was begun, including pool therapy and stationary biking. At this time, no recurrence of symptoms was reported.

**Discussion**

Traumatic PTT dislocation is a rare and often misdiagnosed injury. As with our patient, definitive treatment is often delayed by months. In the limited cases that have been documented, nonoperative treatment is usually unsuccessful in returning patients to their previous level of function. It also appears that despite a delay in diagnosis and treatment, patient outcome is not compromised. We did not encounter (nor find described in available studies) sequela of treatment, physical examination and history of current illness remain the most reliable diagnostic tools and surgical treatment appears successful in the short term. However, more long-term follow-up is needed to determine the risk and benefits of surgical procedures used to treat traumatic PTT dislocation.

**References**


**Abstract**

Single- and dual-component revisions have typically been used to correct coronal malalignment after total knee arthroplasty (TKA). However, realignment of well-fixed components can result in complications such as bone loss and increasing constraint. On the other hand, the use of angled polyethylene inserts as an extension of the tibial baseplate produces outcomes similar to those of tibial-component revisions but is a relatively easy procedure and has shorter operating times. Regardless of which surgical plan is pursued, the goal of treatment is to restore the coronal alignment of the knee to between 2.4° and 7.2° of valgus. We present a patient in whom a revision TKA using a 14-mm polyethylene insert (placed first) in the right knee led to unsatisfactory laxity, whereas a 16-mm insert (placed second) in the baseplate led to correction of malalignment.

**Case Report**

A 74-year-old woman who underwent TKA of the right knee in January 2006 presented to our clinic in March 2013 with symptoms of pain and instability of the right knee. We performed a revision TKA using two polyethylene inserts and achieved stability in varus and valgus stress levels. Postoperatively, the patient was satisfied with her ambulation. The use of angled polyethylene inserts in revision TKA may be as effective in treatment of malalignment as osteotomy and may provide better clinical outcomes than component revisions.

**Introduction**

Coronal plane malalignment and resultant aseptic loosening, pain, instability, and accelerated polyethylene wear are common reasons for revision of total knee arthroplasty (TKA). Malalignment is generally caused by technical errors during TKA, including inaccurate bone cuts, failure to recognize and address preoperative deformity, inaccurate placement of referencing guides, and improper templating. Posttraumatic fracture malalignments may make intraoperative referencing a challenge, and knee replacement for posttraumatic arthritis has an increased risk of infection, malalignment, flexion instability, and aseptic loosening. Attempted “corrections” of varus and valgus malalignment are poorly tolerated after TKA and commonly cited reasons for revision procedures.

Malalignment can be treated surgically by single- or dual-component revision or exchange to an angled polyethylene insert. However, the revision of well-fixed components in the component revisions can result in bone loss and increasing constraint. On the other hand, the use of angled polyethylene inserts as an extension of the tibial baseplate produces outcomes similar to those of tibial-component revisions but is a relatively easy procedure and has shorter operating times. Regardless of which surgical plan is pursued, the goal of treatment is to restore the coronal alignment of the knee to between 2.4° and 7.2° of valgus. We present a patient in whom a revision TKA using a 14-mm polyethylene insert (placed first) in the right knee led to unsatisfactory laxity, whereas a 16-mm insert (placed second) in the baseplate led to correction of malalignment.

**References**


**Abstract**

Single- and dual-component revisions have typically been used to correct coronal malalignment after total knee arthroplasty (TKA). However, realignment of well-fixed components can result in complications such as bone loss and increasing constraint. On the other hand, the use of angled polyethylene inserts as an extension of the tibial baseplate produces outcomes similar to those of tibial-component revisions but is a relatively easy procedure and has shorter operating times. Regardless of which surgical plan is pursued, the goal of treatment is to restore the coronal alignment of the knee to between 2.4° and 7.2° of valgus. We present a patient in whom a revision TKA using a 14-mm polyethylene insert (placed first) in the right knee led to unsatisfactory laxity, whereas a 16-mm insert (placed second) in the baseplate led to correction of malalignment.

**Case Report**

A 74-year-old woman who underwent TKA of the right knee in January 2006 presented to our clinic in March 2013 with symptoms of pain and instability. Both the patient and her family were concerned because her symptoms markedly decreased her overall mobility. For the past 6 months, she had fallen frequently when her right knee buckled into valgus position, and also said that her knee assumed a knock-knee position with normal ambulation. The patient had type 2 diabetes mellitus, hypertension, asthma, and surgically treated breast cancer, but no fevers or chills. She was a nonsmoker with a body mass index (BMI; kg/m²) of 29. Results of laboratory tests for inflammatory factors were normal. The patient did have a history of diaphyseal fractures of both the right tibia and right femur. The 2006 operative report on treatment of the fractures indicated that Zimmer NexGen cruciate-retaining implants (Warsaw, IN) were used with a 10-mm anterior constrained liner.

The patient’s right knee showed a range of motion from full extension to 120° of flexion and global laxity throughout extension, midflexion, and flexion. Overall, the lower extremity had valgus alignment, which was passively cor-
Case Report

rectable to neutral alignment, and strong pedal pulses with intact sensory and motor neurologic function. Radiographic evaluation included three views of the right knee, as well as a standing hip-to-ankle view to assess overall limb alignment. The radiographs showed TKA of the right knee with a cruciate-retaining implant. The tibiofemoral angle was at 17° of valgus (Figure 1A). There was an apex lateral post-traumatic deformity in the subchondral region of the right femur and an apex medial posttraumatic deformity in the midshaft region of the right tibia, with the mechanical axis crossing the far lateral quadrant of the knee (Figure 1B). The femur and tibia showed 9° and 7° of valgus, respectively (Figures 2A and 2B), relative to the anatomical axis.

The patient was periodically assessed in the clinic for 12 months. Because of persistent pain and knee instability, multiple medical problems, older age group, and low level of physical activity, we decided to use an angled polyethylene insert exchange rather than a two-component revision to treat the knee surgically. Based on the results of radiographic templating, we ordered two custom-made angled polyethylene inserts with 8-mm lateral buildups (Figure 3). Two inserts were ordered to increase intraoperative options for improving knee stability while correcting coronal malalignment.

At the time of surgery, the femoral and tibial components were well fixed with stable interfaces and no evidence of surface damage (Figures 4A and 4B). The previously placed polyethylene insert was removed and it showed evidence of lateral side wear, particularly anteriorly. No signs of infection were detected. The 14-mm polyethylene insert was placed first; however, the knee continued to show unsatisfactory laxity, particularly in flexion. When the 16-mm insert was placed and locked into the baseplate, we observed excellent correction of both malalignment and knee instability. The patient began to ambulate quickly after surgery and was discharged from the hospital on postoperative day 2.

Six months after surgery, clinical and radiographic evaluation indicated a successful outcome. Although 3° of full extension was lost, no complications occurred, and knee flexion at 120° has been maintained. The knee was stable to varus and valgus stress throughout its arc of motion, and the patient was much more satisfied with her alignment and knee stability during ambulation. Standing hip-to-ankle radiographs revealed a tibiofemoral angle at 7° of valgus (Figure 5A) and that the mechanical axis of the right lower extremity was passing through the center of the knee (Figure 5B).

Discussion

As little as 5° of valgus has been shown to increase strain in the medial collateral ligament to levels approaching the failure limit, with maximum strain occurring at 60° of flexion. Higher failure rates have been associated in valgus alignment greater than 7.4° compared with neutral alignment (failure rates, 1.4% vs 0.6%). Additionally, valgus malalignment after TKA can result in higher strain in the tibia (which may predispose patients to aseptic loosening) than either neutral or varus malalignment because the lateral compartment contains less stiff cancellous bone than the medial compartment. Valgus malalignment may also contribute to altered patellofemoral mechanics, including patellofemoral instability, possibly leading to anterior knee pain. Both coronal varus and valgus malalignment have been shown to result in chronic instability, particularly in full extension of the knee.

The risks of revision TKA include infection, stiffness, bone loss, neurovascular complications, and damage to the extensor mechanism. Postoperative pain, recovery, and rehabilitation may be problematic. Moreover, revision TKA may require additional techniques for exposure, the addition of augments for implants, and increased levels of implant constraint. Studies of isolated polyethylene exchange, however, have described low complication rates; minimal loss of motion; failure rates between 9% and 29%, principally for aseptic loosening; technically easier procedures compared with component revisions; and shorter operating times. However, the main indication for isolated polyethylene exchange in most of these studies, unlike our case, was osteolysis rather than malalignment or instability, which contributes to the elevated rates of aseptic loosening.

Although Shaw and Murray first reported the use of angled inserts to correct deformity in 1978, little information on custom-made angled polyethylene inserts is available. In a study by Sah et al, angled polyethylene insert exchange was used to treat excessive posterior slope, with excellent outcomes. Subsequently, Sah et al used angled polyethylene insert exchange in nine patients with coronal plane deformities caused by tibial component malposition, with similar excellent results. These findings are encouraging, but data on the longevity of these implants, extent of correction, and complications remain limited.

Although the importance of coronal alignment after TKA is well described, revision TKA to correct valgus...
Unicamer Bone Cyst of the Pelvis in a 13-year-old Boy Treated with Cannulated Screw Decompression After Open Curettage and Grafting: A Case Report

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Abstract

Although studied for more than a century, the cause of unicameral bone cyst (UBC) remains uncertain. UBC of the pelvis in younger patients has been particularly problematic because its rarity often results in misdiagnosis and improper treatment. Surgical treatment has typically involved curettage and bone grafting; however, some studies have described the use of a continuous decompression device to address high recurrence rates of the lesion. We present a 13-year-old male patient in whom, after two unsuccessful operations, open curettage and grafting and insertion of a cannulated screw led to resolution of pain caused by a large, recurrent UBC in the left ilium. Results of clinical examinations 1.5 years after the third operation indicated successful treatment. The use of a cannulated screw after open curettage and grafting may provide a clinically effective option for treating UBC.

Introduction

Originally described by Virchow1 in 1876, a simple or unicameral bone cyst (UBC) is a benign, fluid-filled lesion that affects tubular and flat bones. Eighty percent are found in the pelvis with contrast material revealed a multiloculated fluid-filled lesion in the left ilium; however, neither evidence of a solid component to the lesion nor fluid-fluid levels were observed. We describe one patient in whom a large, recurrent UBC in the left ilium led to worsening pain, whereas open curettage and grafting and insertion of a cannulated screw led to excellent reduction in pain and a return to competitive sports.

Case Report

In January 2011, a 13-year-old male cross-country runner presented to our clinic with pain in the left hip for the past year. The pain began spontaneously, without any history of trauma, and usually occurred while running. No pain was reported at rest or at night. The patient had noticed an increase in the size of his left hemipelvis relative to his right. On initial physical examination, the patient was tender to palpation posteriorly in the region of the left sacroiliac joint and anteriorly inferior to the anterior superior iliac spine. He also had pain with hip flexion greater than 70°, which worsened with internal and external rotation. Results of sensory, motor, and vascular examinations in the left lower extremity were unremarkable, but testing in flexion, abduction, and external rotation of the left hip recreated the patient’s posterior pain. A radiograph of the pelvis revealed a large expansile lytic lesion in the left ilium (Figure 1). An image obtained by magnetic resonance imaging (MRI) of the pelvis with contrast material revealed a multicavitous fluid-filled lesion in the left ilium; however, neither evidence of a solid component to the lesion nor fluid-fluid levels were detected. The MRI image did show signs of mild cortical thinning and expansion. After evaluating the image, we determined that the most appropriate diagnosis was UBC, with aneurysmal bone cyst being a less likely possibility.

In February 2011, the patient underwent open curettage and bone grafting with a posterior approach to the left ilium. Subperiosteal dissection was performed until the expanded cortex overlay the lesion, after which a cortical window was developed and clear yellow fluid was encountered in improper treatment. We describe one patient in whom open curettage and grafting for a large UBC in the left ilium led to worsened pain, whereas open curettage and grafting and insertion of a cannulated screw led to excellent reduction in pain and a return to competitive sports.
irrigated and packed with 120 mL of cancellous allograft chips. Results of a pathological study of the lesion were consistent with UBC. Postoperatively, the patient noted gradual lessening of activity-related pain in his left hip; between 6 and 10 months after the initial procedure, however, the pain worsened to preoperative baseline. A radiograph (Figure 2A) and a computed tomography (CT) image (Figure 2B) obtained at 10 months showed reappearance of the lesion in the left ilium.

About 12 months after the first operation, the patient underwent another open curettage and bone grafting of the lesion in the left ilium. The skin was incised along the previously cut surgical scar using a similar posterior approach. Curettage was performed, the cavity was irrigated, and the opening was packed with 30 mL of cancellous allograft chips. Results of a pathological study were consistent with recurrent UBC, and a cyst wall was observed. Postoperatively, the patient’s pain resumed and gradually worsened. By September 2012, he ambulated with a persistent limp.

Successive computed tomography images of the ilium obtained after the second procedure and pelvic angiography show a recurrent, large lytic lesion in the left ilium.

After evaluating a pelvic angiogram, we performed an alternative method to surgery by arterial embolization in the posterior division of the left internal iliac artery supplied by the ilioinguinal approach. A cannulated screw was inserted into the cystic lesion (harvested from the right iliac crest) by an ilioinguinal approach. A follow-up CT scan showed continued incorporation of the allograft, with a small persistent cystic component in the posterior aspect of the ilium (Figure 4). At 16 months after the third procedure, the patient remained asymptomatic (Figure 5) and results of a hip examination indicated pain-free range of motion with no tenderness.

Radiograph obtained at 16 months after the third procedure shows the successful treatment of the unicameral bone cyst, with no recurrent lesion and a cannulated screw inserted in the left ilium.

The findings of the current case are also consistent with the high risk of recurrence after surgical treatment of UBC. Published recurrence rates have been high (up to 50%) after open curettage and grafting, with larger cysts most likely to recur. Most authors recommended complete removal of cyst lining before grafting, although some suggested placing continuous decompression devices such as cannulated screws to decrease recurrence rates. In a case series of 26 patients, Tsuchiya et al17 found success rates of 80% and 100% when inserting either a titanium cannulated screw or cannulated hydroxyapatite pin, respectively, after curettage and grafting. Interestingly, the only twice-recurrent lesion was UBC of the ilium. Recurrence in our case reflects the difficulty in accessing the entirety of a large, iliac UBC by using one approach.

Although the difficulties in diagnosis and treatment are well described, pelvic UBCs continue to present a challenging problem to surgeons and younger patients. Our study exemplifies the problems in diagnosing and treating a large UBC of the ilium. However, the successful outcome with use of a cannulated screw after open curettage and grafting may offer an effective method of treatment.

Discussion

The findings of the current case are consistent with the diagnosis of UBC. Radiographs and CT scans of pelvic UBC generally show lytic lesions centered between the inner and outer table of the ilium, with the cyst fluid measured less than 20 Hounsfield units.18 In our study, MRI images revealed the multiloculated fluid-filled nature of the lesion; however, the lesion did not show fluid-fluid levels or solid components, which would have been more indicative of aneurysmal bone cyst or fibrous dysplasia, respectively.11 Despite imaging findings consistent with simple cyst, results of a pathological study were needed to confirm the diagnosis. Results of the two independent pathological studies of samples of the cyst lining indicated a fibrous membrane with occasional giant cells, which is consistent with signs of UBC.3

The goals in treating UBC are to prevent future pathologic fracture and lessen pain associated with the cyst by encouraging bone to fill in the cavity.15 Surgical treatment, which ideally entails fewer procedures and complications, can be separated into percutaneous (including aspiration, autogenous bone marrow injections, steroid injections, and curettage and grafting) and open techniques (including curettage and grafting and subtotal resection).13-15 Additionally, some authors advocated the use of cannulated screws, K-wires, or flexible intramedullary nails to provide continuous decompression of fluid within the cyst to stimulate healing.11-12 Hou et al12 reported a significantly shorter time to solid union of UBCs treated with curettage and grafting and decompression with a cannulated screw compared to curettage and grafting alone or percutaneous procedures.

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References

Scaphoid Stress Fracture in a 65-year-old Man with Low Bone Mineral Density: A Case Report

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Abstract

Although commonly reported in women and less commonly in younger athletes, no studies have reported stress fractures of the scaphoid in older, sedentary men. Because of its rarity, osteoporosis in older men is often unrecognized and only diagnosed after the fracture. I describe a previously sedentary 65-year-old man who presented to my clinic with pain in the right wrist after his first day of intense physical activity and underwent 8 weeks of splinting and bracing for treatment of a fracture of the waist of the scaphoid. Ten weeks after the pain began, a computed tomography image revealed healing of the fracture with mild deformity and the results of a bone densitometry test met the criteria for osteopenia. Nontraumatic wrist pain in older male patients may be a clinical sign of fragility stress fracture, which can indicate low bone mineral density and subsequent risk of metabolic bone disease.

Introduction

Stress fractures are often associated with repetitive impact loading and have been reported in athletes, laborers, military recruits, and patients with underlying metabolic disease. This type of fracture mainly affects pre- and post-menopausal women in the lower extremities. Stress fractures of the wrist are much less common but have been described in younger athletes (associated with competitive gymnastics, badminton, cricket, soccer goalkeeping, and platform high diving)." However, no studies have reported stress fractures of the scaphoid in sedentary older men. In the current case, a previously sedentary 65-year-old man developed acute wrist pain after a repetitive stress event. He was under the care of an endocrinologist for treatment of type 2 diabetes mellitus and hypothyroidism when the pain began. This case highlights the importance and management of a nontraumatic scaphoid stress fracture and its probable indication of osteopenia.

Case Report

A male attorney aged 65 presented to my clinic with pain in the right wrist. At the advice of his primary care physician, he resumed physical aerobic exercise and tennis after 20 years of a sedentary lifestyle. The patient drank alcohol on occasion and never used tobacco. On the first day of exercise, he participated in intense striking drills with a tennis ball for an hour. The next day, he noticed pain, limited range of motion, and mild swelling in his right wrist. No direct injury to the wrist was reported, and the patient did not have a history of wrist trauma. Initial radiographs obtained by his previous orthopaedic surgeon were read as “mild wrist arthritis,” but the symptoms did not resolve with rest, splinting, or nonsteroidal medications. His pertinent medical history included seasonal allergic airway disease, hypothyroidism controlled with oral medication, hypertension, type 2 diabetes mellitus, and kidney stones.

Two weeks after the onset of wrist pain, he was referred to an endocrinologist for treatment of type 2 diabetes mellitus and hypothyroidism. The patient was asymptomatic before this presentation and had no history of abnormal bone density.

On physical examination, the patient had a body mass index of 24.8 kg/m2. His right wrist was mildly swollen and painful to palpation in the area of the anatomical snuff box. The range of motion of his wrist was limited in radial and ulnar deviation and extension. Results of a neurovascular examination were normal, and pain was felt over the scaphoid during the Watson shift test.

Radiographs of the wrist obtained 2 weeks after the pain began revealed a possible fracture of the waist of the scaphoid. The range of motion of his wrist was limited in radial and ulnar deviation and extension. Results of a neurovascular examination were normal, and pain was felt over the scaphoid during the Watson shift test.

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the scaphoid with mild osteoarthritic changes in the scaphotrapezial-trapezoidal joint. Osteopenia in the proximal pole of the scaphoid was also noted (Figure 1). Images obtained by magnetic resonance imaging revealed a complete scaphoid waist fracture with mixed signal changes in the proximal pole, which was suggestive of avascular necrosis (Figure 2). No signs of carpal collapse or fragmentation were detected, and the scapholunate and lunotriquetral ligaments were intact.

Figure 1. Radiographs of the right wrist obtained 2 weeks after pain started show possible osteopenia in the proximal pole of the scaphoid and a subtle line of a fracture in the waist of the scaphoid consistent with a stress fracture. Mild osteoarthritic changes in the scaphotrapezial-trapezoidal joint are also noted.

Figure 2. Coronal magnetic resonance imaging T1-weighted image obtained 2 weeks after pain started shows the non-unioned fracture of the waist of the scaphoid and proximal pole changes suggestive of avascular necrosis.

Figure 3. Obtained 10 weeks after the pain started, a computed tomography image of fine-cut sagittal bone window in line with the long axis of the scaphoid shows a healed fracture with minimal humpback deformity.

Discussion

Stress fractures of the wrist are uncommon but have been reported in cases of repetitive stress and younger athletes. However, relative to normal aging, the risk of osteopenia and osteoporosis increases, resulting in secondary fragility and insufficiency fractures that are directly associated with decreasing bone mineral density. Metabolic bone disease such as osteoporosis has been linked to frailty fractures in both men and women, although no scaphoid stress fractures were reported in middle- to older-aged sedentary men. In the current case, underlying secondary osteopenia may have caused a stress fracture of the waist of the scaphoid.

Although osteoporosis has been associated mostly with older women, results of the Framingham study in 1992 revealed that loss of bone density in the femoral neck was linear with age and equivalent in men and women. The prevalence rates of osteoporosis in men are lower than women because of three main factors: men have increased accumulation of bone mass during development, slower declines in hormonal function with age, and shorter life spans. The higher peak in bone mineral density with men compared to women results in a 10-year age gap of fragility fractures of the hip, vertebrae, and distal radius (i.e., an 85-year-old man would have about the same absolute bone mineral density as a 75-year-old woman). A patient with primary or secondary osteoporosis uncouples the normal process of bone formation and resorption, which leads to net loss of bone density and increased risk of fracture. Primary osteoporosis is more common, accounting for about 80% of osteoporosis in women and 50% in men. Secondary osteoporosis accounts for 50% of the cases in men, is typically multifactorial, and can arise as a consequence of lifestyle factors, diets, eating disorders, endocrinopathies, systemic disease, organ dysfunction, neoplasm, and as the result of treating these conditions. Indirect and direct loss of bone density is ultimately related to altered osteoclast and osteoblast function.

It is estimated that more than 2 million men in the United States have osteoporosis. Most of the cases of osteoporosis are unrecognized and diagnosed only after the fracture. As many as 85% of all hip fractures and 90% of all vertebral fractures in older-aged men are associated with osteoporosis. Men have a 13% to 25% risk of developing osteoporosis in their lifetime and a 33% to 47% risk of developing osteoporosis after age 50, compared with a 50% risk for women in both cases.

Nontraumatic wrist pain in middle- to older-aged men should alert clinicians to a possible fragility stress fracture and orthopaedic surgeons to potentially diminished bone density, as described in this case. Workup should include evaluation of underlying disease processes that may contribute to decreased bone mass suggestive of secondary osteoporosis. In addition to managing the fracture, the goal of treatment is to lower the risk of additional fractures and preserve quality of life, and interventions should limit future bone loss.

References

Lipoma of the Index Finger in a 64-year-old Man: A Case Report

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Abstract

Lipomas are benign tumors composed of adipose tissue and typically encountered in middle-aged patients. Although the etiology remains unknown, this lesion can occur throughout the body. However, it is rarely seen in the finger. Typical treatment has often involved observation, but excision techniques have also reported successful outcomes. We describe a 64-year-old male patient who reported to our clinic with a painless, soft-tissue mass in the index finger of his left hand, and we performed operative excision for treatment. The findings of physical examinations, radiographs, and magnetic resonance imaging tests had indicated the presence of lipoma, and results of pathological tests confirmed this diagnosis. Surgeons should carefully evaluate benign soft-tissue masses of the finger, with careful consideration given to the rare yet possible presence of lipoma.

Introduction

Lipomas are benign tumors composed of fat (adipose) cells. The lesion is normally encountered in middle-aged patients who describe the presence of a painless, mobile, soft, and subcutaneous mass. Although the precise etiology is still unknown, lipomas usually form when mesenchymal cells differentiate into fatty tissue. A signet-ring cell, marked by a peripherally located nucleus and central lipid droplet, is a typical characteristic. Additionally, the tumor can be found throughout the body, and about 15% to 20% localize in the overlying the middle phalanx of the index finger. The patient was dissatisfied with the cosmetic appearance and concerned about continued growth of the mass. It had been present for 6 months, enlarging slowly. The mass was located between both the radial aspect of the middle phalanx and proximal interphalangeal joint. No previous trauma, associated pain, and numbness or loss of motion was reported.

Case Report

A 64-year-old, right-handed male maintenance supervisor presented to our clinic with a soft-tissue mass in the index finger of his left hand. The patient was not dissatisfied with the cosmetic appearance and concerned about continued growth of the mass. It had been present for 6 months, enlarging slowly. No previous trauma, associated pain, and numbness or loss of motion was reported. In physical examination, the mass was firm, lobulated, and measured about 1 cm and 1.5 cm in length and width, respectively, on the radial side of the middle phalanx. The finger was well-perfused, and the mass was not tender to palpation. Additionally, no overlying redness or fluctuants was observed. The resulting distance of a static two-point discrimination test was 6 mm on the finger, during which time no motor deficits or loss of motion was noted. Three radiographs of the left hand revealed soft-tissue swelling underlying the middle phalanx of the index finger but no bony abnormalities. Magnetic resonance imaging (MRI) T1- and T2-weighted images of the left hand showed a lobulated mass (isointense to fat) in the same location. After discussing treatment options, the patient decided to undergo operative excision.

The entire lesion was treated surgically with a simple excision while the patient was under regional anesthesia. A mid-lateral incision approach was used, and the radial neurovascular bundle was visualized and protected in the volar flap. The soft-tissue mass was well circumscribed and removed without great difficulty (Figure 1). In gross appearance, the pale-yellow excised mass was 2.3 cm, 2 cm, and 1.4 cm in length, width, and height, respectively, with a general appearance similar to adipose tissue. The results of a pathological test were consistent with lipoma (Figure 2).

Discussion

Lipomas have infrequently been reported deep in the palm within the Guyon canal and the carpal tunnel. These lesions are usually asymptomatic, but one case noted paralysis in the extensor muscles of the thumb and finger. The findings of our case were consistent with several reports that did not describe a history of trauma associated with lipoma of the finger. Additionally, no studies have reported recurrence of the lesion. Although the report on two cases of lipoma by Gupta et al described ultrasound techniques for initial diagnosis, we felt that the findings of our radiographic and MRI evaluation of the soft-tissue mass (enlargement but no calcification or bony abnormalities and isointense to fat, respectively) provided sufficient indication of lipoma.

Lipomas are seldom found on the finger, yet many authors have emphasized the importance of differential diagnosis for successful treatment. Attention should be given to infections or lesions with characteristics similar to lipoma. In the differential diagnosis of a soft-tissue mass in the finger, physicians should be aware of possible epidermal inclusion, ganglion, and mucoid cysts; giant cell tumors of the tendon sheath; glomus tumors (especially beneath fingernails); and melanomas. However, the rarer possibility of lipoma of the finger should still be considered during evaluation of benign soft-tissue lesions.

References


Figure 1. Intraoperative exposure of the soft-tissue mass, which shows a general appearance similar to adipose tissue.

Figure 2. Histological features of the dissected soft-tissue mass show mature fat cells typical of lipoma.
Another year, another wonderful event. Thanks to the dedication of the Perry Initiative and local volunteers, the University of New Mexico (UNM) Department of Orthopaedics & Rehabilitation hosted the Perry Outreach Program on Saturday, March 14, 2015. Forty female high school students from New Mexico underwent a selective application process to participate in both hands-on workshops and open discussions in orthopaedic surgery and engineering. The program—led by volunteers such as surgeons, residents, and medical students—came to a close with a question-and-answer (Q&A) session. Our next generation of biomedical professionals departed with goody bags, internship opportunities, and a better understanding of the essential collaboration between surgeons and engineers.

At 9:15 am, when parents had trickled (almost reluctantly) away and their daughters had assembled (most eagerly) in a conference room, the day began. Dr. Deana M. Mercer started the morning lecture with three themes: the power of knowledge, cultural boundaries pertaining to women, and time management. Although many people think of a practicing surgeon’s day-to-day life as a blur of lab coats and stethoscopes, few appreciate what goes beyond the operating room—and Drs. Mercer, Selina R. Silva, Jessica C. McMichael, and Elizabeth A. Mikola were more than willing to share the details. Hands shot up like fireworks: “What’s a typical day like?”, “Why did you go into orthopaedics?”, “How many hours do you have to work?”, “How old were you when you finished with school?” Regardless of how personal the question, the doctors did not sugarcoat responses. Above all, the idea of balance in work?”; “How old were you when you finished with school?”

Participants were also taught the importance of suturing techniques, using both practice boards and pig feet. Amidst the sounds of whizzing drills and intakes of breath, one could also make out the buzz of constant chatter from doctors and medical students explaining procedures and responding to inquisitive looks.

After more than 2 hours of training, a buffet of pizza, salad, and lemonade met its doom when faced with ravenous participants and volunteers. As satisfied stomachs and smiles settled in the conference room, Dr. Christina Salas described her role as a biomedical engineer and the important relationship between engineers and orthopaedic surgeons. She then introduced Dr. Elizabeth L. Dirk, a professor in the UNM School of Engineering. Similar to that of a surgeon, the world of an engineer is unknown to those outside the profession. However, as Drs. Salas and Dirk illuminated, little advancement would have occurred or continue to occur in modern medicine without original investigations. This essential research—dedicated to providing the right implants and devices for the right procedure—provided yet another career path for the young women to consider.

The students left the conference room at 12:45 pm and began the afternoon workshops of intramedullary (IM) nail fixation, casting, and repairing compound fractures of the proximal femur. In the module on IM nail fixation, expressions of joy or terror while wielding a hammer were tolerated thanks to the firm instruction given by medical students. Casting on the upper extremity may have seemed simple, but the actual attempt perhaps enlightened such a notion (Figure 2). Finally, to show an alternative method to IM nail fixation, synthetic femur bones were repaired using screws and plates. As usual, time escaped without warning—only the arrival of curious friends and family members signaled that the day was coming to a close.

At 4:15 pm, when high school participants learning to locate and expose the ulnar nerve that may have seemed simple, but the actual attempt perhaps enlightened such a notion (Figure 2). Finally, to show an alternative method to IM nail fixation, synthetic femur bones were repaired using screws and plates. As usual, time escaped without warning—only the arrival of curious friends and family members signaled that the day was coming to a close.

To provide feedback, we solicited responses from both the Perry Initiative and UNM Department of Orthopaedics & Rehabilitation, School of Engineering, and School of Medicine, respectively, whose time and efforts dedicated to the program made the event and this paper possible: Kate Ordemann and Julia Pagashucci, Julia Bowers, Ryan Wood, Elizabeth Mikola, MD, Jessica McMichael, MD, Selina Silva, MD, Heather Menzer, MD, Heather Woodin, MD, Jaime Cloyes, CPNP, Aviena Ortega, RN, and Austin Grace, MA; Elizabeth Dirk, PhD; Taylor Parnall, Ericka Charley, Lisa Toelle, and Jessica McGraw.

Acknowledgments

We thank the following volunteers from both the Perry Initiative and UNM Department of Orthopaedics & Rehabilitation, School of Engineering, and School of Medicine, respectively, whose time and efforts dedicated to the program made the event and this paper possible: Kate Ordemann and Julia Pagashucci, Julia Bowers, Ryan Wood, Elizabeth Mikola, MD, Jessica McMichael, MD, Selina Silva, MD, Heather Menzer, MD, Heather Woodin, MD, Jaime Cloyes, CPNP, Aviena Ortega, RN, and Austin Grace, MA; Elizabeth Dirk, PhD; Taylor Parnall, Ericka Charley, Lisa Toelle, and Jessica McGraw.
Celebrating the Life, Laughter, and Leadership of Dr. Dale V. Hoekstra

Robert C. Schenck Jr, MD*

*UNM Department of Orthopaedics & Rehabilitation

On behalf of his loving wife, Stephanie “Stevie” Hoekstra, and his family, I would like to celebrate the life of Dr. Dale Vandermeer Hoekstra. He was a husband, father, and colleague to so many—yet a dear friend to all. Almost 7 years ago, Dale adopted the University of New Mexico (UNM) Department of Orthopaedics & Rehabilitation into his own family. He passed away on November 3, 2014, and we will miss our family member dearly.

I first want to express my deep gratitude to each UNM Hospital nurse, staff member, physician, and surgeon who cared so lovingly for Dale during the 2 weeks before his passing. Stevie, myself, and all of us who knew and loved Dale are humbled by this selfless effort. Thank you to all of Dale’s wonderful caregivers.

Dale was born in Detroit, Michigan, in 1945 and for many years called the Michigan area home. In 1963, he graduated from Highland Park High School and wanted to be a pilot, as well as have someone pay for his college education (the consummate businessman at 18 years of age). Subsequently, Dale applied and was accepted to the United States Air Force Academy. Health issues, however, lead Dale into the path of medicine—to which we are grateful!—and in 1971 he graduated from Wayne State University School of Medicine in Detroit. In San Antonio, Texas, Dale met his future wife, Wenda “Wendie” Vilven (marrying her in 1949). He completed his medical internship at the same hospital in 1972 and subsequently was interrupted during World War II when he served in the US Army, although this time as a commissioned officer. After a distinguished 20-year military career, Dr. George Elbert Omer Jr became the first chairman of the University of New Mexico (UNM) Department of Orthopaedics & Rehabilitation in 1970 and served until 1990. During this time, he was president of multiple national orthopaedic societies and founded one of the first divisions of hand surgery in North America. Dr. Omer trained more than 300 residents and faculty members who went on to practice in New Mexico and the western United States. Our first chairman put New Mexico on the orthopaedic map, creating a strong foundation upon which the department continues to flourish.

George was born on December 23, 1922, (5 years before his sister Betty) at Bethany Hospital in Kansas City, Missouri, to George Elbert Sr and Edith Mae. His family moved to a variety of towns in Kansas between 1920 and 1940, a historic period encompassing both the Roaring Twenties and Great Depression. His father was a dentist, and George had two uncles who were physicians.

Particularly influenced toward a medical career thanks to his summers spent with Uncle Will, George attended Fort Hays State College (now University). His education was interrupted during World War II when he served in the United States (US) Army Medical Corps in 1943. Afterward, George resumed his studies and attended the University of Kansas for medical school, where he would meet his future wife, Wenda “Wendie” Vilven (marrying her in 1949). He completed his medical internship at the same hospital in which he was born.

In 1950, with the outbreak of the Korean War, he rejoined the US Army, although this time as a commissioned officer. George—now Dr. Omer—was first posted in the 82nd Airborne Division in Fort Benning, Georgia. At one point, a patient had refused to follow rehabilitation orders, claiming that the doctor was “not one of us.” Motivated rather than discouraged, however, Dr. Omer subsequently completed his paratrooper training and proudly obtained his jump wings. While at this post, his two sons, George Eric and Michael Lee, were born.

During the Korean War, Dr. Omer developed extensive experience in treating soldier-patients with traumatic orthopaedic injuries. In 1952, he was offered an orthopaedic residency at the Brooke Army Medical Center (BAMC) in San Antonio and obtained his master’s degree from Baylor University. In the late 1950s, Dr. Omer wrote articles for the Kansas Historical Society, obtained his pilot’s license, and established five centers of subspecialty care in hand injuries (for which he received a commendation and promotion). From 1962 to 1965, he directed the orthopaedic residency program at Walter Reed National Military Medical Center and taught an annual course at the Armed Forces Institute of Pathology.

During the height of the Vietnam War, he returned to BAMC for his final posting as assistant chief of surgery, chief of orthopaedic surgery, and chief of hand surgery—a time in which he would become known as “The Peripheral Nerve Man.” Dr. Omer was clinically and academically invested in treating damage to the peripheral nerve, and he published studies on hundreds of patients with upper-extremity nerve injuries. He firmly believed that documented research between medical fields was key to understanding these injuries in BAMC and beyond.

Dr. Omer treated many high-profile patients, including President Lyndon Johnson while both were in Washington, DC. In 1969, former-president Johnson returned to Texas and continued to see Dr. Omer who was then working in San Antonio. On a particularly hot summer day, one of these visits resulted in funding for air conditioning in some of the BAMC orthopaedic clinics.

In 1970, Dr. Omer was recruited to UNM by Dean Robert Stone and previous Division Chief Jim Weaver who both wanted someone to lead the orthopaedic group. Dr. Omer incorporated various existing entities into a new orthopaedic department. These organizations included the Carrie Tingley Hospital in Truth or Consequences; Gallup Indian Medical Center; Department of Veterans Affairs of New Mexico.
Mexico, and the existing but limited clinical orthopaedics enterprise affiliated with UNM School of Medicine at Bernalillo County Medical Center. Dr. Omer also initiated the Carrie Tingley Hospital Winter Conference, which continues to meet annually to this day.

As chairman, Dr. Omer organized clinical facilities into a cohesive group, established regiments training beyond clinical apprenticeship, created an academic curriculum of relevant topics and assigned readings, and emphasized balanced student and teacher responsibility in learning. He incorporated national standards into education, with formalized participation in the Orthopaedic In-Training Examination administered by the American Academy of Orthopaedic Surgeons.

When the residency program was better established, Dr. Omer turned his attention to faculty recruitment and subspecialty divisions, founding one of the first divisions of hand surgery in North America. In 1977, he performed one of the first toe-to-hand transplants in a child. Another watershed moment occurred in 1976 with the recruitment of Dr. Moheb S. Moneim who brought great expertise in microsurgical technique and enthusiasm to clinical work.

Dr. Omer was actively involved in many regional, national, and international orthopaedic organizations. He was an original member of the American Society of Surgery of the Hand and served as president in 1978. Dr. Omer was also a long-time member of the American Orthopaedic Association, serving as president in 1989. Furthermore, he served a 10-year term (1981-1991) on the American Board of Orthopaedic Surgery, which included a year of presidency in 1987. While on the Board, he oversaw the process for re-certification of all orthopaedists and the introduction of the Certificate of Added Qualification for hand surgery.

After his retirement as chairman in 1990, Dr. Omer continued his practice by lecturing, writing, and caring for patients. He served on national and international advisory boards for numerous medical publications while remaining actively involved with several organizations, including the National Aeronautics and Space Administration, National Football League, Navajo Nation, and Carrie Tingley Hospital. Dr. Omer was awarded the “Pioneers of Hand Surgery” status in 1995 by the International Federation of Societies for Surgery of the Hand—the Nobel Prize equivalent for hand surgeons. In 1999, the Society of Military Orthopaedic Surgeons honored Dr. Omer with an annual memorial lecture series at RAMC.

Dr. Omer’s life and career spanned three phases of orthopaedic surgery in the U.S. From 1920 to 1945, when George was growing up, orthopaedics was a nonoperative specialty. During Dr. Omer’s military career from 1945 to 1970, orthopaedics had shifted into an operative specialty. Finally, his academic career from 1970 to 1990 encompassed the change of orthopaedics into an implant-intensive specialty, with advanced surgical techniques such as arthroscopy and microsurgery.

Dr. Omer left behind an international legacy in treating traumatic war-related injuries (particularly peripheral nerves of the upper extremity) and establishing the subspecialty of hand surgery, whereas his regional legacy is carried on today by the hundreds of residents and fellows he trained at the UNM orthopaedics department and division of hand surgery. The development of this department continues to prosper under the enormous, steady foundation established by Dr. Omer. For that, we all owe him a great debt of gratitude.

The lifetime work of Dr. Elizabeth Ann Szalay in orthopaedics actually began, I believe, with her upbringing as a native New Mexican. She graduated from Los Alamos High School, Class of 1970, which gave her a special understanding of the needs and disparities of our very unique and beautiful state. This was Elizabeth’s initial training as a caring physician. Elizabeth is a true shining star of New Mexico, with undergraduate and medical degrees obtained at the University of New Mexico (UNM) College of Medicine, fellow students, and co-residents will remember her intellect, humor, and work ethic.

Elizabeth’s residency was at a premier “hands on” orthopaedic surgery program in San Antonio, Texas, from 1979 to 1983, alongside thought-leaders such as Drs. David P. Green, Charles A. Rockwood, and Kaye E. Wilkins. Elizabeth excelled in an extremely active and resident-independent program within a truly male-dominated world. I believe this was a big driver in her later phenomenal mentoring of women, having trained with mentors who were also excellent but only had the XY chromosome. Dr. James D. Heckman fondly remembered Elizabeth’s visiting rotation in San Antonio during the residency matching process. By chance, Elizabeth had stopped to eat at Paesanos, the old-school Italian restaurant where the selection committee was meeting, and Dr. Heckman was able to tell her—right there—that she had been accepted at the University of Texas at San Antonio for residency.

Elizabeth cemented her love of pediatric orthopaedics and research at Texas Scottish Rite Hospital for Children (TSRHC), and she took her first “real orthopaedic job” with Dr. Neil E. Green at Vanderbilt University in Nashville, Tennessee. One of her “Vandy” orthopaedic surgery residents, Dr. Milton L. “Chip” Routt, remembered her high expectations. He recently told me of one story I call “Clover Bottom Clinic.” This clinic provided treatment of severe deformities in children who were without care until Elizabeth’s arrival. Her dedication to the underserved at the Clover Bottom Clinic is what many of us hope for in an orthopaedic career, and Elizabeth continued working with this ethic in New Mexico, Ecuador, and India. As Dr. Charles E. Johnston from TSRHC notes, her love of caring for those who cannot get care really defined Elizabeth. For this exemplary work for the underserved, Elizabeth personally received the 2015 Pediatric Orthopaedic Society of North America (POSNA) Humanitarian Award this past fall. She will be formally honored again in May 2015 at the POSNA annual meeting in Atlanta, Georgia.

New Mexico was lucky when two acquaintances from 7th grade reconnected at a 30-year high school reunion. Thereafter, Drs. Elizabeth Szalay and Kenneth (Ken) Gilman were married. We received a great wedding present with Elizabeth’s arrival at UNM in 2012, and she became, in my mind, a thought-leader and academician extraordinaire here at UNM Department of Orthopaedics & Rehabilitation. Elizabeth was the chief of pediatric orthopaedics and, in 2007, the first female orthopaedic surgeon to receive full professorship with tenure at UNM Health Sciences Center.

She loved publishing and cracked out 13 excellent peer-reviewed papers from 2006 to 2012. Her expertise included two related topics: bone health in children and reading bone densitometry (DEXA) scans. These subjects were fertile areas for research, especially at UNM Carrie Tingley Hospital. Elizabeth collaborated with Drs. Susan K. Root and received $58,000 from the Children’s Miracle Network to create the Carrie Tingley Pediatric Bone Health Center, which offers the only bone health program for children in New Mexico. Since 2006, Elizabeth published approximately 30 papers, two-thirds on bone density and DEXA scans. But one of my favorite contributions of Elizabeth concerns cultural competence. It is often said “you can never go home,” but Elizabeth was lucky to do so. Her landmark paper in 2009 discussed a wonderful example of cultural competence that a native New Mexican or Westerner would easily understand. Elizabeth and her co-authors compared treatment outcomes between rural and urban children with club foot who received a brace, with particular focus on patients who identified as Navajo. The study included many important findings, but one I believe is quite remarkable: when positive constructions in speech were used, doctors could better explain treatment methods to the rural families. Negative images in Navajo beliefs were felt to bring bad
luck (eg, “If your child doesn’t wear the brace, his or her foot will be crooked and will need surgery”), whereas a better approach was positive teaching (eg, “If your child wears the brace, his or her foot will be straight”). Elizabeth was able to come home to New Mexico, use her knowledge of our culture, and give us this landmark paper. She taught us to culturally understand how to teach.

When Elizabeth became ill, she told Jude McMullan to give away her books and told many of us similar wishes. But Elizabeth, like everyone in her church, believed in healing and, gratefully, she made the decision to work and live. After this, Elizabeth went back to Jude and asked, “Who gave away my books?” During this 2-year period, she published 10 papers, saw patients, performed operative procedures, read DEXA scans, taught medical students and residents, and most importantly, mentored and loved the many orthopaedic residents and colleagues in our region and nationwide. Both her passion for mentoring and many friendships are what really set apart Elizabeth’s career.

In closing, I would like to say one word... balance. Elizabeth’s academic career is powerful, yet her unwavering dedication to her native home and loving relationships with Ken and her family are uncommon in such careers. Many orthopaedic surgeons sacrifice much for what Elizabeth accomplished. Her interests outside of work (art and music, to name two) in combination with her powerful spirituality allowed her profession to skyrocket. This balance in life made her career even more spectacular. My condolences to her husband Ken, her loving stepchildren and family, and all of her supportive friends and colleagues. Elizabeth’s memory will remain a powerful mentor.

Dr. John Morrison Veitch died peacefully at his house on January 18, 2015, after a brief battle with brain cancer, surrounded by loving family. John was 69 years old. John was the middle child of five siblings born to Abner and Bessie Veitch. He was raised in Lisbon, North Dakota. His father, Abner, was a country doctor who had a clinic and surgery suite in the front of their home. John attended the University of North Dakota for 3 years and went on to the college’s medical school with his brother, Bob, for 2 years. John completed his third and fourth years at the University of Minnesota, during which he met Mary Ellen and married her on the day after graduation. They were married for 44 years.

John did his surgery internship in Indianapolis, Indiana, where Mary Ellen and he welcomed their son Andrew (Andy) into the world. After finishing the internship, John began his public service obligation in the United States Army as a chief medical officer. He was stationed for 2 years at Fort Greely in Alaska and 1 year at Fitzsimmons Army Hospital (now Fitzsimmons Army Medical Center) in Denver, Colorado. John and Mary Ellen welcomed their second son, Charles (Charlie), while in Alaska. After 3 years of service, John was honorably discharged as major.

In the 1970s, John underwent his orthopaedic residency and hand fellowship training at the University of New Mexico (UNM) under Dr. George E. Omer. Soon after, John and Mary Ellen moved their young family to Fort Dodge, Iowa, so John could begin his private practice. But, not surprisingly, the Land of Enchantment called them back, with an opportunity to move his practice alongside Dr. Stanley R. Lehman in Roswell, New Mexico. John worked for 13 years as a general orthopaedic surgeon and, with Mary Ellen, raised his two boys in southern New Mexico.

After their kids graduated from Goddard High School in Roswell, the couple moved to Joplin, Missouri, because the chance had arisen for John to be primarily a hand surgeon (hand surgery being his true passion in orthopaedics). John had a busy practice in Joplin for 10 years. He tried his hand at retirement but grew bored, and subsequently UNM Department of Orthopaedics & Rehabilitation would become very lucky. John accepted a position at UNM as a part-time faculty member in the division of hand surgery, working for the UNM orthopaedics department for 7 years before retiring in 2010—this time sans boredom. John, an outstanding teacher, was awarded the UNM Orthopaedic Faculty Instructor of the Year in 2004. He was an active member of the American Academy of Orthopaedic Surgeons and American Association for Hand Surgery.

Outside of orthopaedics, John loved spending time with his family, hiking and hunting in New Mexico, reading (especially biographies), studying foreign languages, and of course, John was a big fan of the New Mexico Lobos. He is survived by his siblings, Tom, Bob, Jim, and Marge; his loving wife, Mary Ellen, and their two sons, Andy (Class of 2003) and Charlie, along with Andy’s wife, Beth; and two granddaughters, Elle and Emma. John would have been 70 years old on February 15th, 2015. We will miss him dearly.
A Gentleman Surgeon, Richard V. Worrell, MD

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Dr. Richard Vernon Worrell—the first orthopaedic oncologist in the state—began his invaluable work in New Mexico in 1987. Dr. Worrell served the University of New Mexico (UNM) Department of Orthopaedics & Rehabilitation well, especially by filling voids: he directed the general orthopaedic service at the Veterans Administration (VA) Medical Center for years, provided musculoskeletal oncology care at UNM Hospital, and even came out of retirement when the department lacked sufficient faculty. Throughout his career and retirement, he regularly participated in orthopaedic-related conferences and Grand Rounds. Dr. Worrell was a great mentor to orthopaedic residents and junior faculty while also providing life-saving, compassionate care to many patients. He passed away in October 2014.

Richard was born on June 4, 1931, in Brooklyn, New York, to John Elmer and Elaine Worrell. In the 1960s, he performed his orthopaedic residency at the University at Buffalo in the same state, in addition to serving in the US Army Reserve Medical Corps. After having a private practice for about a year, Dr. Worrell developed an interest in the academic aspect of medicine. In 1968, he became the first chairperson of the Department of Orthopaedics at the University of Connecticut School of Medicine, serving until 1970. During this time, he met his future wife, Audrey M., who was working as a professor of psychiatry. Dr. Worrell filled various roles (including professor, clinical instructor, chief, assistant dean, and director) at several institutions throughout the 1970s and early 1980s.

Dr. Worrell’s career continued to be marked with success and recognition. He relocated to Albuquerque (with Mrs. Worrell!!) in 1987 and, fortunately for us, completed his academic career here. He became a professor at the UNM orthopaedics department, eventually serving as the vice chairman. To better care for patients, Dr. Worrell focused his efforts on recruiting faculty for the VA and UNM Hospital orthopaedic services. He not only took on the role of chief of the orthopaedic surgery division at the VA, but also directed the orthopaedic oncology services at UNM Cancer Center to provide in-state treatment for patients.

In addition to his clinical work, Dr. Worrell contributed to the academic aspect of medicine. He published two editions of *Orthopaedics: Principles of Basic and Clinical Science* with Dr. Felix Bronner (providing the first formal curriculum for our orthopaedic residency program) and numerous scholarly articles and lectures. Dr. Worrell was a member of prestigious organizations such as the Orthopaedic Research Society, American Academy of Orthopaedic Surgeons, and American Society of Clinical Pathologists, while also an oral examiner for the American Board of Orthopaedic Surgery.

Dr. Worrell was a gentleman and a fine surgeon. He brought tremendous subspecialty care and expertise in the field of musculoskeletal oncology to New Mexico and the growing clinical mission of the UNM orthopaedics department. His contributions to this department—and to this state—created a lasting foundation for future services. The legacy of Dr. Worrell lives on through his children, Phillip and Amy, his loving wife, Audrey, and the countless residents, patients, and friends whom he cared for dearly. I am proud and appreciative to have known him as a friend and partner.
Journal Submissions

The University of New Mexico Orthopaedics Research Journal Submission Instructions for Authors

The University of New Mexico Orthopaedics Research Journal (UNMORJ) highlights research done by the faculty, fellows, residents, students, staff, and alumni associated with the UNM Department of Orthopaedics & Rehabilitation.

General Policies

Articles are accepted for exclusive publication in the UNMORJ; previously published articles are not accepted. Each author warrants that his or her submission to the journal is an original work. All reports of prospective clinical trials submitted for consideration for publication must have been registered in a public trial registry such as clinicaltrials.org. All manuscripts describing a study with human subjects must include a statement that the subjects provided informed consent to their participation and that the study was approved by an institutional review board. All manuscripts describing a study in animals must include a statement that the study was approved by an institutional animal use committee. The UNMORJ uses the criteria for authorship of the International Committee of Medical Journal Editors (ICMJE). That is, all persons designated as authors must (1) make substantial contributions to the conception and design of the work or the acquisition, analysis, or interpretation of data; and (2) draft the manuscript or revise it critically for important intellectual content; and (3) provide final approval of the version of the manuscript to be published; and (4) take responsibility for all aspects of the work, especially with respect to its accuracy and integrity. All sources of financial support for research described in a submitted manuscript must be identified on the title page. The UNMORJ does not require authors of articles published in the journal to assign copyright to the journal; copyright is retained by the authors.

Manuscript Format

The UNMORJ invites submission of the following types of original articles: reports on clinical or basic science research, case reports (including case series), reviews, technical notes, and reflections. Manuscripts must be submitted as Microsoft Word documents. Use Times New Roman 12-point typeface and double space everything, including the list of references and the tables. Use 1-inch margins on the top, bottom, and both sides of each page. Do not justify the right-hand margin; use “ragged right.” Number all pages in the manuscript continuously, beginning with the title page, in the upper right-hand corner. With some minor exceptions, the UNMORJ follows the style, format, and usage guidelines described in the AMA Manual of Style (10th edition).

Title Page

Titles of manuscripts should be concise, specific, and informative. Do not use abbreviations in the title. Aside from the title, the title page should include (1) the authors’ full names, highest academic degrees, and affiliations; (2) the name and address of the corresponding author, including his or her telephone number, fax number, and email address; and (3) any sources of funding for the research described.

Abstract

An abstract must be included on the second page of the Word file containing the manuscript. Abstracts of original-research reports and reviews are limited to 250 words; abstracts of case reports and technical notes must be no longer than 150 words. Original-research reports require a structured abstract with the following headings: Background/Purpose, Methods, Results, and Conclusions. Reviews, case reports, and technical notes do not require a structured abstract.

Text

Define all abbreviations at first mention. Use generic names for drugs and SI units for measurements.

Original-Research Reports

Original-research reports are limited to 2500 words, excluding the reference list, with the text organized under the following headings: Introduction, Methods, Results, and Discussion. Include a paragraph describing the limitations of the study at the end of the discussion section. No more than 25 references should be cited.

Case Reports

Case reports should be no longer than 1200 words, excluding the reference list, with the text organized under the following headings: Introduction, Case Report(s), and Discussion. Case reports should not contain an extensive review of the literature; the maximum number of references is 15.

Reviews

The maximum length of a review is 3200 words, excluding the reference list, which is limited to 40 references. The headings used depend on the topic.

Technical Notes

Technical notes describe a modification of, or a helpful “tip” for, a previously documented procedure. Technical notes are limited to 1200 words, excluding the reference list, with the text organized under the following headings: Introduction, Technique, and Discussion. Technical notes should not contain an extensive review of the literature; the maximum number of references is 15.

Reflections

The UNMORJ also welcomes submission of opinion essays and personal reflections on orthopaedic-related topics. Abstracts, acknowledgments, and structured headings are not required, although tables, figures, and references are accepted. Reflections are limited to 1000 words, excluding the reference list, and adhere to the basic formatting style for manuscripts.

Acknowledgments

The acknowledgments section is placed at the end of the text, before the new page on which the reference list begins. People listed in the acknowledgments section are those who helped with some aspect of the reported research but do not meet the criteria for authorship described above. Examples of those who might be acknowledged are statisticians, laboratory technicians, physicians who contributed patient data but were not involved in the study design or preparation of the manuscript, administrators who secured funding for the research, and people who provided writing or editorial assistance.

References

All references must be cited in the text of a manuscript, in the order of their mention in the text, by using a superscript number. The reference list should not be alphabetized. “Personal communications” cannot be included on the list of references. The reference list should begin on a new page placed after the end of the text of the manuscript. References are to be formatted in AMA style except that the abbreviations for journal titles and book titles are not italicized, there is no period after the abbreviation, and the complete number of the last page of the reference is not given (for example, use 345-9 instead by 345-349). Use the abbreviations for journal titles specified by the National Library of Medicine (PubMed). The names of all authors of each reference should be provided unless there are more than six, in which case the names of only the first three are given, followed by “et al.” Examples of the UNMORJ reference style are shown below:

Journal Article


Book Chapter


Entire book


Graphic Elements (Tables and Figures)

Tables and figures should complement, not duplicate, the text of a paper. Neither the tables nor the figures are embedded within the text of the manuscript: the tables are placed at the end of the Word file, whereas the figures are submitted separately as graphic files.

Tables

Tables are placed in the Word document after the reference list, with one table to a page. Use the Word table function, not PowerPoint or a spreadsheet, to compose tables. Each table must be numbered (Arabic numerals) and have a title at the top.

Figure Legends

All figure legends must be placed together, in the order of their citation in the text, on the last page of the Word document containing the text and tables. The figure legends should not be placed on the figures themselves. All figures must be numbered (Arabic numerals). Figures can have more than one part (for example, Figure 1A, Figure 1B, etc).

Figures

Each figure must be submitted separately in EPS, TIFF, PPT, or JPEG format.

Magnification, internal scale markers, and stains must be included on the figures when appropriate. Make sure that any information that could be used to identify a patient has been removed from photographs or other images.