MESSAGE FROM THE PRESIDENT

Hello everyone. While at the ASSH meeting Dr. Bindra and I slipped out to Red Rock for a site visit. The hotel and conference facility at Red Rock are well suited to our meeting. The guest rooms, conference rooms, exhibit hall, and instructional courses are all in close proximity. The ubiquitous casino is adjacent, close but avoidable.

The hotel has activities for families and includes a bowling alley. We decided against changing the annual golf outing to a bowling tournament however. If you are coming to Red Rock please remember it is about fifteen miles from the Vegas strip. If you want to take in some shows or go down to the strip please consider your transportation. Although there are plenty of activities at the Red Rock location, if you plan to come and go a lot it may be worth considering a car rental.

The program for Red Rock looks good. We have invited the Brazilian Society as our guests and have some excellent scientific presentations from Brazil. Nerve transfers, implant arthroplasties, treatment of Dupuytren’s, and transplantation are some of the “hot topics” in hand that will be explored.

I have invited a professor from MIT as the presidential guest lecturer. Dr. Srinivasan is the director of the “touch lab” and will talk to us about the science of haptics. This is a fascinating look at sensibility from an engineering perspective and will not disappoint you.

Terry Light is the Danyo invited guest lecturer and will speak about the switch from books to digital education. The combined guest lecturer is Steven Levitt, the author of Freakonomics who will speak on Saturday morning.

Steve McCabe

Georgette Fogg has organized the specialty day for Wednesday around the topic of hand trauma. She has put together a series of panels with James Chang giving an invited address. Sheel Sharma has organized the review course for Friday afternoon.

The meeting is well supported by industry and I believe it will live up to your expectations regarding the scientific and social program. Please come to Red Rock to teach and learn and to have some fun with your colleagues.

Steve McCabe
Balancing Act

As the AAHS prepares for the upcoming annual meeting, we are excited about the upcoming event. Registration numbers are up with a large contingent from our international partner, Brazil. It is going to be an exciting meeting with a great opportunity to learn, exchange ideas, and socialize with your colleagues.

In addition to preparations for the annual meeting, we are coming to the end of the year. A time of significant activity. Whether it is preparation for the holidays, closing out the fiscal year, or preparing a talk for the upcoming annual meeting, there is no shortage of activities to consume our free-time. As we continue to move ahead with health care reform it may mean implementing a new electronic medical record, learning how “meaningful use criteria” applies to our practices, or gearing up for ICD-10.

As I work through the end of my year, it seems more difficult to stay focused on the issues that matter most. In an effort to get my year concluded, it is easiest to eliminate those activities that have no obvious deadline. Spending time with my family, teaching my residents and fellows, and spending more time with my patients are all items that seem to suffer this time of year, probably when it is most important to dedicate more time to these endeavors.

So for this month’s column, I am proposing improved balance in our practices and our lives. Taking more time for family and friends will always be a better choice than doing another case. Taking more time for introspection and education will enhance your ability to care for your patients.

Maintaining this balance can be difficult. It requires constant awareness of the choices we are making and how they affect this balance. It requires constant vigilance to repeatedly reassess priorities. We have to make it a priority to have balance. If we do not, the scales will quickly tip toward the side of work, stress and chaos.

We have to make it a priority to have balance. If we do not, the scales will quickly tip toward the side of work, stress and chaos.

2012 Annual Meeting
Keynote Speaker

Professor Steven Levitt has agreed to be our distinguished keynote speaker at the 2012 Annual Meeting. Professor Steven Levitt is the author of the bestselling book, *Freakonomics*, and *Superfreakonomics* and is the William Ogden Professor of Economics at the University of Chicago. He is also a contributing author to the NY Times with his weekly blog, Freakonomics which has also been turned into a movie.

**Saturday, January 14, 2012**
10am – 11am
Red Rock Casino and Resort
Las Vegas, NV

HAND SURGERY Quarterly

President
Steve McCabe, MD, FACS
Editor
Thomas Hughes, MD
Managing Editor
Lorraine M. O’Grady

*Hand Surgery Quarterly* is a publication of the American Association for Hand Surgery and is published strictly for the members of AAHS. This publication is designed as a forum for open discussion and debate among the AAHS membership. Opinions discussed are those of the authors or speakers and are not necessarily the position, posture or stance of the Association.

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HAND THERAPISTS PROFILE: Lisa M. Cyr, OTR/L, CHT

PERSONAL
I grew up in Massachusetts then headed west to college. After I graduated, I moved to Connecticut where I live with my husband, step-son and two dogs. I’m very active and spend my non-working hours hiking, bike riding kayaking and doing Zumba. I also love to go for long rides on the back of my husband’s motorcycle.

EDUCATION
I graduated from Colorado State University with a BS in Occupational Therapy, and became a CHT in 1996. I am currently enrolled in a Doctorate of OT program at Rocky Mountain University of Health Professions with an anticipated graduation date in the summer of 2012.

EMPLOYER
I have been employed at the Center for Orthopaedics since 2000. I was initially hired as the sole hand therapist to shadow our hand surgeon at three of our four sites. In 2004 I also became the therapy manager of a staff of 18. I still spend the majority of my time treating patients among the three offices. This affords me the opportunity to provide direct and indirect supervision to most of the staff while they are working in their normal routines. This seems to be a beneficial set up to promote consistency among front desk personnel, and continuity of care among the therapy staff.

AAHS INVOLVEMENT
I became a member of AAHS in 2009 when I realized ‘all the cool kids’ were members.
In January of 2010, I was nominated to be one of the two new Affiliates on the Nominating Committee. My involvement with AAHS was part of the impetus for me to return to school for an advanced degree.

BEST PART OF MY JOB
I’ve been a hand therapist for over 16 years. I am still overwhelmed with emotion when I see patients’ faces light up when they discover that they can do something with their injured extremities that they never thought they’d be able to do again.
I love the intimacy, creativity and therapeutic relationships that develop and evolve as I work with someone with a potentially devastating injury and assist them in the process of restoring range of motion and function in whatever capacity they are capable.

MAJOR ACCOMPLISHMENTS
Becoming a CHT was the one of my greatest professional achievements.
I have been incredibly fortunate to cross paths with several people who have enabled me to publish in both the Journal of Hand Therapy and in a chapter in a book on splinting (or fabricating orthoses as it is now called).
I am also incredibly blessed to be a part of the Guatemala Healing Hands Foundation team and have travelled to Guatemala on two hand therapy/surgery missions with the team.

CLINICAL SPECIALTIES
Orthopedic trauma. I work very closely with my hand surgeon and am fortunate to see most patients soon after their injuries before secondary complications develop.
I believe that it’s critical to be in tune with the psychosocial aspects of an injury to help patients cope with the trauma they have sustained. This can greatly influence the healing process. I also love to fabricate custom orthoses. This gives me an opportunity to express my creative side.

GREATEST PROFESSIONAL CHALLENGE
Getting the courage to volunteer to speak at an AAHS conference.

THREE WORDS THAT DESCRIBE ME:
LIVE 4 2DAY
This issue of Hand Surgery Quarterly focuses on nerve injuries and repair. To reflect this focus, coding guidelines for a variety of nerve procedures will be covered. We will not cover carpal tunnel surgery or other neuroplasty procedures.

For digital nerve injuries in the hand, two codes are utilized: CPT 64831 describes the first digital nerve that is repaired, while CPT 64832 describes each additional nerve repair. Repair of major peripheral nerves, like the median nerve, is similarly reported: CPT 64856 or 64857 is used to describe the first nerve repaired. Though 64856 includes transposition of the nerve as part of the procedure, it appears that 64857 reimburses more without the nerve transposition. CPT 64859 is utilized for each additional major peripheral nerve repair.

When coding for nerve grafts, distinctions are made for the length of the grafts obtained, the number of strands used to span a defect, and the location of the nerve reconstruction. For single strand repairs in the hand or arm, CPT 64890-64893 are used. For cable or multiple grafts up to 4 cm in length, CPT 64895 is used. For cable grafts greater than 4 cm in length, CPT 64896 should be listed.

CPT 64910 is defined as a nerve repair using a synthetic conduit. It is important to note that the synthetic conduit must be used to span a defect between cut ends of a nerve and not simply as a nerve wrap. When using conduits as a nerve wrap such as in cases of carpal tunnel revision surgery, for example, CPT 64999 (unlisted procedure, nervous system) can be listed but is subject to review by the payer.

Unfortunately, no code exists to describe nerve repair with allograft. For now, surgeons are encouraged to use CPT 64910 (nerve repair; with synthetic conduit) or CPT 64911 (nerve repair; with autogenous vein graft). However, these codes do not accurately describe the work of allograft nerve reconstruction and may not be reimbursed.

Keep in mind that wound debridement codes (CPT 11042-11047) may be applicable to claims associated with nerve injuries. When performing debridement of a single wound, report the depth using the deepest level of tissue removed and the surface area of the wound.

**Use of Operating Microscope (CPT 69990)**

CPT 69990 is a designated add-on code and may be separately reported when using an operating microscope for microscopic repairs. Do not append modifier 51. This code should be listed immediately following the primary procedure on the claim form. While CPT 64831 (suture repair of digital nerve) is paid 19.92 Relative Value Units (RVUs), 69990 reimburses an additional 6.48 RVUs. Medicare allows reimbursement for modifier 80 (assistant surgeon) on 69990.

An important caveat: When repairing nerves with synthetic conduits, 69990 cannot be used in

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conjunction with 64910 (nerve repair with synthetic conduit) or 64911 (nerve repair with autogenous vein graft). Of course, 69990 cannot be reported for the use of magnifying loupes.

CPT 69990 may only be reported one time per operative session and cannot be listed more than once on a claim form, even if the operating microscope is used for multiple vessel or nerve procedures. There are a number of procedures that “bundle” use of the operating microscope and will not allow separate reporting of 69990. These procedures include:

- 15756-15757 Free myo/skin/microvascular procedures
- 20955-20962 Bone graft with microvascular anastomosis
- 20969-20973 Free graft with microvascular anastomosis
- 26551-26554 Toe to hand with microvascular anastomosis
- 26556 Free toe transfer with microvascular anastomosis
- 64727 Neuroplasty requiring use of operating microscope
- 64910-64911 Nerve conduit

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**Calendar**

**2012**

January 11-14
AAHS 42nd Annual Meeting
Red Rock Casino Resort & Spa
Las Vegas, NV

January 18
The Philadelphia Hand Society Mid-Winter Meeting
Visiting Lecturer: Jorge L. Orbay, MD

March 3-5 (Surgery)
Hand Rehabilitation Foundation
2012 Surgery and Therapy Symposia, Loews Philadelphia Hotel, Philadelphia, PA

March 3-6 (Therapy)
Hand Rehabilitation Foundation
2012 Surgery and Therapy Symposia, Sheraton City Center Hotel, Philadelphia, PA

March 25-29
The 2012 Upper Extremity Tutorial, Snowmass Village, CO

June 21-23
XVII FESSH Congress, Antwerp, Belgium

October 18-21
ASHT 35th Annual Meeting, Sandiego, CA

November 15-17
American Society for Reconstructive Transplantation 3rd Biennial Meeting, Chicago, IL

**2013**

January 9-12, 2013
AAHS 43rd Annual Meeting
Naples Grande Resort & Club
Naples, FL

**2014**

January 8-11, 2014
AAHS 44th Annual Meeting
Grand Hyatt Kauai Resort & Spa
Kauai, HI
Around the Hand Table

Panel Discussion: Peripheral Nerve

Moderator:

Warren Hammert, MD
Associate Professor, Department of Orthopaedics
Associate Professor, Department of Surgery, Plastic
University of Rochester

Panelists:

Jeffrey B. Friedrich, MD
Assistant Professor, Plastic Surgery Division
Adjunct Assistant Professor, Department of Orthopedics
University of Washington

Jonathan E. Isaacs, MD
Associate Professor and Chair, Division of Hand Surgery
Virginia Commonwealth University

Robert A. Kaufmann, MD
Assistant Professor of Orthopaedic Surgery
Division of Hand and Upper Extremity Surgery
University of Pittsburgh

Heather C. Smith, MS, PT, CHT, Cert. MDT
Senior Therapist-Hand Rehabilitation Department of Orthopaedics
University of Rochester Medical Center

Dean Sotereanos, MD
Professor, Orthopaedic Surgery
Drexel University College of Medicine
Vice Chairman, Orthopaedic Network Development, Department of Orthopaedic Surgery

Warren: I appreciate everyone taking time to participate in this roundtable discussion regarding peripheral nerve conditions. I thought we would start off and talk about digital nerve injury because that is something common that all hand surgeons treat. So, starting off with Jeff, when you have an isolated digital nerve injury, what are your thoughts on repairing them primarily versus using a conduit or something else?

Jeff: As my practice has evolved, I have a lower and lower threshold for using either a conduit or a nerve graft. I used to try to repair most of these injuries primarily, including saw injuries, which I think has proven to be ill-advised because I think with the kerf of a saw, that zone of injury is probably bigger than I appreciated. So currently, I trim the digital nerve injuries back to very good looking nerve, and I almost always have to use something for those rather than doing a primary repair. I just feel like I can no longer justify keeping those digits down in a flexed position during the early healing. Regarding the conduits and grafts, I would say that I do a mix. It is probably a 50-50. I like the PIN for digital nerves but I have been very happy with the conduits also. A lot of it has to do with resident and fellow education and making sure they are exposed to different methods. So, for me it is usually one or the other. The only primary repairs that I find that I am doing are sharp knife lacerations, but most of what I see in my practice is not the sharp injury amenable to primary repair.

Warren: Okay. Rob, any other thoughts or anything different that you do with isolated digital nerve injuries?

Rob: I couldn’t have echoed his sentiments more. I agree that the zone of injury is generally underestimated at the initial time and I normally get to these problems quite soon. I have been using mostly nerve conduits but I also use autografts for longer defects. When the gap is greater than 2.5 cm, I will use the posterior interosseous nerve and I have been happy with that nerve.

Warren: What type of conduit do you prefer? In your opinion, is there a difference in the collagen conduits versus the PGA/PLA conduits or any of the others that are out on the market?

Rob: I use the collagen conduits primarily because that is what I have the most experience with. I know that there is literature support for the PGA, which is perhaps even favorable in comparison to the collagen, but in my hands I have been very happy with the collagen. It is just the ease of use- I know how it handles and I feel quite comfortable with it.

Warren: When you irrigate these after repairing the nerve, do you think we need to use heparinized saline or just saline by itself? There is not a consensus opinion as some surgeons advocate using heparinized saline to irrigate to try to prevent clots from forming inside the tube that may block or impede axonal regeneration, while other surgeons use saline. What is your preference?

Rob: I use saline. I have read about the need for heparinized saline but I don’t know if it really matters if there is a little clot inside the tube. I don’t think it is truly going to prevent the nerve from regenerating through that conduit and in my experience it hasn’t mattered.

Warren: Does anybody think there is a benefit to irrigating with heparinized saline?

(continued on next page)
Hand Table

Participants: Probably not. I would agree with that as well.

Warren: Jonathan, I know you have some experience working with allograft nerves. What is your thought on the role for allograft nerve versus conduit for repair of isolated digital nerve injuries?

Jonathan: First off, I don’t think we know the answer to that question, which is why we are putting together a multi-center clinical trial. However, my current feeling from my own interpretation of the literature and my own observations is that conduits are great but only for relatively short distances.... I believe shorter distances than what most people are using them for. I think a conduit probably is a good option for defects less than 15 mm, but after that I think it becomes unpredictable. So, once the defect is greater than 15 mm, I usually turn towards the allograft. The benefit of the allograft being that it maintains an internal structure to guide the axons as opposed to counting on a stable fibrin clot (like you would see inside a nerve conduit). The fibrin clot becomes less stable with greater distances and can make the results less predictable. Of course the disadvantage of the allograft is that you have to have two suture lines. So, I think there is a balance. They both have a place in digital nerve reconstruction and I generally make my decision based on the length of the defect.

I would add with regards to the nerve tubes, I think that when you talk about the choice of different types of nerve tubes that the Neurolac, which is polycaprolactone, has a hard surface and there is a risk of these eroding through the skin. So, I think that those probably don’t have a great role in digital nerve reconstruction.

Warren: I agree the stiffness of the Neurolac tubes can be problematic and I have had soft tissue breakdown over those tubes, so I prefer the collagen tubes. Do you have a distance where you think that there is no longer an advantage to allograft and you prefer to use autograft? Does it matter if the defect is 2.5, 3, or 4 centimeters?

Jonathan: For a digital nerve injury, my cut off would be 5 cm, but this is based on the fact that it is currently the longest available allograft. You know, it bothers me to harvest a nerve and create a defect to reconstruct a sensory nerve. But, I think it depends on which nerve you were talking about replacing. I would be more likely to consider an autograft for the ulnar aspect of the thumb or radial aspect of the index finger.

Warren: What are your thoughts or experience taking MABC or LABC for nerve grafts as opposed to the PINs? Obviously, the PIN is easy because it is in the same extremity and there is minimal, if any donor site morbidity - any experience with the MABC or LABC nerves autografts?

Jonathan: Well, I have been getting away from autografts, but in the past, I have had patients develop painful neuromas after using the MABC as a donor nerve. You never have a patient who is going to say, “I couldn’t do such and such activity because I had numbness on the inside of my forearm”, but what you do have is people that say, “Boy, it sure hurts when I lean on this part of my elbow.” So, that has been one of my main reasons for avoiding the MABC. Interestingly, I have not had very many problems with sural nerve grafts.

Warren: Okay, we previously mentioned problems with stiffness in some of the conduits and the potential for soft tissue problems and this leads me to the next point I would like to discuss. Dean, considering that many times digital nerve injuries are combined with flexor tendon lacerations and/or fractures and more significant soft tissue injuries, or the so-called combined injuries, often the nerve injury is a secondary thought and the primary concern is the tendon or osseous injury. In those situations where you may require specific rehabilitation program, do you do anything different with your nerve repairs?

Dean: Well, at least my thought in regards to that Warren are that obviously if there is a tendon injury, you want to mobilize that tendon, particularly for zone 2 injuries. A primary nerve repair is certainly not amendable to that, so I certainly would use a conduit or an allograft to enable moving the finger at the same time, and not having to come back and do a tenolysis because of the nerve injury. I think that is a perfect indication to do a conduit or a graft of some type. I personally never use an autograft for anything anymore. I have just preferred not to risk the morbidity of harvesting an autograft, be it from the MABC/LABC or PIN for that matter. Why risk any additional morbidity? So I tend to stick with either conduits or allografts. I do use (continued on page 10)
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**Hand Surgery Quarterly**

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conduits, but generally for shorter defects, a centimeter or less. There are also porcine mucosal conduits available, which are about a centimeter long and I find them great for digital nerves.

Warren: Do you have a preference in these combined injuries along with tendons or fractures when the defect is too long for the submucosal conduit (2 to 3 cm), conduit versus allografts?

Dean: My preference is that it depends on the size and the length of the defect and how much tension there is. If it is two centimeters or less, I would probably use a conduit, which would be the vast majority of what I use. If it were a longer defect then I would use an allograft of some type. I think most hand surgeons know is that the longer the defect, especially in a traumatic situation, the less likely they are going to get anything other than protective sensation. So, once again, why risk an autograft in that situation? I personally think that a conduit or a allograft would give you the same result, which would be protective sensation, in something longer than say three centimeters, but in someone who is young, less than 20 years old, in which I have seen excellent results with long defects.

Warren: Okay, Heather, when it comes to rehabilitation following these types of injuries, any trick or techniques that you found useful for either the isolated or the combined injuries as far as improving the nerve gliding and desensitized patients during their recovery?

Heather: I definitely think that early post-op follow-up is important, as far as edema control and early range and motion. Definitely, with the combined injuries as you both are saying, it is important to mobilize them and if they have the conduit and no tension on the repair, you can start the nerve gliding sooner. You really want to start to maximize the excursion or the gliding of the nerve, not causing any strain or over-stretching of the nerve at that point. So, the key things for me are just seeing the patient early, early and often, and getting them moving.

Warren: Any specific tricks on mobilizing the nerve and getting it gliding that you can suggest or recommend?

Heather: With the nerve gliding, you don’t want to put any strain on the repair so you hold the adjacent joint and you are either going to glide proximal or distal to where the repair is located, but you are not going to do both. You want to use a slow oscillatory motion to start gliding and you don’t want to put any tension on the repair. It can be a challenge to teach patients that it should not be painful because they always think that everything we do in therapy is painful. So, it is really important to teach them how to minimize the strain when they are doing their exercises.

Warren: Once the patient is comfortable with nerve gliding, and begins to recover often they have sensitivity in the area. Any tricks for desensitization?

Heather: Yes, usually we start early scar tissue massage and sensory training. Usually we start them with rubbing different textures along their incision and along the distribution of the nerve that was repaired. I usually start that on the first visit and encourage them to continue to do this at home.

Warren: Rob, what are your thoughts on symptomatic, painful neuromas of digital nerves following amputations?

Rob: Well, neuroma pain is very real and it can be quite debilitating. For the digital nerve in particular, my preferred technique for terminal neuromas is to drill little holes usually into the middle or proximal phalanx. It can be anywhere in these bones and obviously as distal as possible. I drill a little hole and then I place the digital nerve into the hole and that has been predictable for me in preventing neuroma pain. Not having sensitivity can be overcome with relative ease. Enduring a painful neuroma, particularly if it affects gripping, can be quite troubling. Another option for more proximal neuromas is placement into muscle, but in my experience, putting them into bone has worked out quite well. Do any of the panelists perform primary neuroma surgeries for a revision amputation? I do because I just feel like that’s my way of preventing neuroma symptoms. I take care of a lot of these, but usually not from my own revision amputations. Is that the standard or am I, maybe, doing more than I should?

Dean: What do you mean, Rob, by primary neuroma surgeries? Do you trim the nerve back or what is it that you do?

Rob: I actually try not to trim the nerve back. I try to leave the injured nerve as long as possible and then I drill little holes in an appropriate location on the medial and lateral sides of the middle or the proximal phalanx of the affected digit, and then I...
tuck those nerves into the bone so that hopefully, they don’t develop symptomatic neuromas.

**Warren:** I see a lot of neuromas, which are symptomatic early, but it is not common that I have to go back and do anything for these. If I need to do an amputation revision, I will identify the nerves and resect them, allowing them to retract proximally away from the scar. Maybe it’s because I have good therapists I work with...but a lot of these are desensitized and don’t need to do something down the line.

**Warren:** Anybody else have any thoughts on that?

**Jonathan:** I’m going to say that my experience has not been the same as Rob’s. I have found that burying the nerve in bone has created almost a potential for traction neuritis—when the patient moves that digit it pulls on the neuroma and causes pain. So I’ve gone away from that.

And when you think about what’s causing a neuroma, it’s that the axons don’t have anywhere to go, they can’t find their path distally. So when you get a neuroma with a nerve repair, it’s because your axons weren’t able to advance along the endoneurial tubes so this may need to be addressed.

But I totally agree with the premise that I think Warren was getting at earlier that they should have a good course of therapy and conservative treatment. You know, one of the issues is that, as we all know, doing surgery for pain, which is what often neuromas are, has a certain level of unpredictability. Since we can’t see pain, we often are not able to “cut” it out.

**Dean:** I generally simply trim the nerve back and typically that works pretty well. Sometimes they do develop a neuroma but that is not common. Terminal neuromas can be relocated very nicely as well. It’s something that’s well described in the literature in the finger. The neuroma is relocated in the interosseous space between the metacarpals. That’s been published in several textbooks. I agree with Jonathon in that I very rarely ever bury a neuroma into bone, either primarily or secondarily, especially if it’s distal to a joint. As the finger moves, there is traction on the neuroma and I’ve seen some problems with that, so that’s not a technique that I typically use, although I know that it is described.

**Warren:** Heather, along those lines for amputation revisions, any techniques or tricks that you think from a therapy standpoint are beneficial to try to prevent patients that are becoming symptomatic and painful?

**Heather:** I have them start using the amputated digit as soon as possible so I have them doing sensory re-training. I have them do things they would typically do every day. The more functional activities I can have them do early on, the less chance they are to develop sensitivity of that neuroma. We also do things where we have them actually submerge their hand into different particles, which can also be very beneficial in desensitization.

**Warren:** So, moving on to the next area. We know that nerve repairs do not always work, so when you have a digital nerve repair that has clearly failed, the patient is not getting return of sensation, has a painful neuroma, and no evidence of recovery or advancing Tinel’s sign. Rob - Do you think there’s a role for revision of the nerve repair? For example, a failed repair along the ulnar aspect of the thumb or radial aspect of the index finger? Do you think that there’s a role to go back and try to re-repair that? Or do you typically just use something that may be more predictable and try to get the symptomatic neuroma out of the way?

**Rob:** I have, so far, always done the latter, which is not try to re-do a nerve repair. And I haven’t really been faced with a younger person that has a border digit neuroma in a location that would benefit from a revision nerve repair. But I would have no problem doing that in the correct setting. It is, however, important not to subject someone to a procedure that has a low likelihood of truly giving them improved sensation.

**Warren:** Jeff, do you have any different experience or any other thoughts on revision of nerves that have not been successful from a repair standpoint?

**Jeff:** No I do not. I haven’t encountered the situation where there’s been a symptomatic neuroma, say on the index or the thumb, to even discuss with the patient about a revision procedure. Even when they do not recover sensation, I find many patients learn to live with it. I have had a few patients that I think have had some benefit from neurolysis when it’s done in conjunction with a tenolysis, but I haven’t done a neurolysis on its own. I don’t think I could justify that as a stand-alone procedure. So, like Rob, I don’t have a problem trying a re-repair, especially in those two digits, but I just haven’t encountered the situation yet.
Hand Table
(continued from previous page)

Warren: Okay, Jonathan, do you have any different thoughts?

Jonathan: If somebody has a clearly dysfunctional or nonfunctioning nerve repair and pain, then I assume the axons were not able to advance down the endoneurial tube. And my first choice in treatment for that is to give those axons a place to go and I will revise that as my primary treatment and redo that nerve repair.

Warren: And when you do that, would you use a nerve tube again, or are you more apt to go to an allograft nerve for a revision.

Jonathan: When a nerve repair does not work, I think usually the problem is you haven’t resected back to normal nerve fascicles out of your zone of injury more than anything else— but I would still step it up a notch. So if I used a conduit I might use an allograft. I’ve not been in this situation but I think that if I had an allograft I might go back and do it with an autograft, trying not to do the exact same thing that was done before.

Dean: This situation, a neuroma in continuity is much different than a terminal neuroma. I would treat a failed repair of a digital nerve injury with a neuroma in continuity with resection of the neuroma and a conduit. I think that works very well and it’s very simple to do.

Warren: Dean, anything you would like to add or anything different with your experience for that?

Dean: For someone with a mixed nerve injury proximally, it is obviously a very difficult situation and I am not sure anecdotally in my own experience that doing cable grafts is any better than using a short conduit in a short defect. I think in a longer defect with a mixed nerve, you are going to be better off either doing a cable graft with either autogenous sural nerve or allograft nerve versus some type of neurotization procedure. I guess my first option, in a primary reconstruction in a short defect, is to use a conduit or allograft. In a longer defect, I would probably still use autograft.

Warren: What is your definition of a short defect for this?

Dean: I would say 2 centimeters or less.

Warren: Jonathan, what is your experience with allografts on mixed nerves?

Jonathan: Minimal. When we are talking about really important nerves, the median or ulnar, as opposed to a digital nerve, there is not enough data to convince me to use allograft. If it were my median or ulnar nerve, I would have it repaired with autograft. As Dean pointed out, there is always some sort of risk and morbidity with taking a nerve, but I feel this is the best available graft material and when you start talking about a really important nerve, I think that you use the best available— as long as the person is willing to accept the donor site morbidity.

Rob: I have used exclusively sural cable grafting for those types of problems and I have had probably the same success or failure. It is a very tough problem. I feel like autografts are the best. It is important to line up the topography and ensure a repair away from the zone of injury.

Warren: Heather, anything from a rehabilitation standpoint when you have more proximal nerve injuries? There is obviously less ability to mobilize the nerves and help them glide. Is there anything different that you would do from a rehab standpoint?

Heather: Yes, they usually are in some type of protective splinting for the first three to four weeks and you are working on protective range of motion. Then, you are going to start (continued on next page)
looking for recovery. So you are going to start looking for advancing Tinel’s sign, and the return of motor function or sensory function. They will often benefit from an orthosis at that point to facilitate function, so if it were a median nerve injury, I might be looking at giving the patient an opponens splint to help with opposition or if it was an ulnar nerve injury, I might be making them an anti-clawing splint to prevent MP hyperextension and help with IP extension. Then basically the same things we talked about before as far as the sensory education and then eventually nerve gliding.

Warren: Okay, I think those are some good points and things that often surgeons don’t think about, particularly with early splinting.

Jeff: If I can ask a question before we move on to the next topic. What are the thoughts about reversing an autograft with the theory being that if you reverse it, there is less chance those axons become misdirected, particularly the small branches? Does anybody else routinely do that?

Dean: I did a study published in The Journal of Reconstruction Microsurgery. I am probably older than a lot of you guys so, about 20 years ago we took a rat sciatic nerve and flipped it. We did this in three different groups. One group was cut and interposed. Another group was reversed, trying to align the topography and the third group was resected and repaired without effort to align the topography. They all did the same. There was no difference in the footprint. We did walking track analysis, PNGs and everything. So, reversing the polarity makes no difference. I think that is well proven.

Warren: Thanks Dean. That was very helpful! Let’s talk about radial sensory nerve injuries. These seem to be fairly common, in the past from external fixation devices for distal radius fractures, but we still see them following sharp injuries and occasionally following deQuervain’s release. Any thoughts on doing anything different with this as opposed to digital nerves? It is obviously a larger diameter nerve and this nerve seems to be more susceptible to development of symptomatic neuromas’s.

Dean: No, I approach them in the same way that I do the digital nerves, with regards again to my philosophy being that those are not real functional deficits by not having sensation on the dorsum of your first web space, but that it is a functional deficit to have the pain associated with the neuroma. So, I do repair these and my algorithm is pretty much the same: direct repair if possible, conduit if short gap or allograft if longer defect.

Jonathan: One thing that I have been doing differently in this particular area, however, is if I am doing a primary repair, I will take a conduit and wrap it around the repair and I think actually that you told me that it was a good idea and that you were doing it. I don’t want to falsely give you credit for something that I am copying now, but I think that you told me that it would decrease the potential of axons escaping and causing pain at the suture site. After dealing with a couple of repaired superficial radial nerves, the patients just really struggle with this comfort. So, I have done that and anecdotally I do think it helps, but I don’t have any real scientific data behind that. Am I right that you were the one that told me to do that?

Warren: I am not the one. I can’t take credit for that, good or bad. I think this, like a lot of other things seem to make sense, but I have not seen any scientific evidence that convinces me this really helps. I think it may make the surgeon feel better, but I don’t know if it does anything for the patient other than increase the cost of the procedure. I understand the concept behind it and hopefully, someone will be able to do a study, at least in an animal model to look at this issue. I also know several surgeons that use this technique. Rob, what are your thoughts on the sensory branch radial nerve? Would you be more apt to resect this and try to get it out of the way, or would you try to repair this specific nerve?

Rob: I very much want to repair injuries to the sensory branch of the radial nerve as neuromas are usually quite painful. Failed deQuervain’s surgery due to injury or aggravation of the dorsal radial sensory nerve, particularly in the work compensation population, can drag on forever. Patients present with a lidoderm patch and I think these injuries are a CRPS creator. So, I try to repair this nerve. If it comes to me and is injured, I do all the same sort of neuroma type efforts that we discussed earlier.

Warren: If you have done a repair and it has failed, then do you try to revise the repair, doing something different the second time, or is your plan to try to move the painful neuroma out of the way, resecting and implantation into a proximal location?

Rob: I am not a big re-repairer. I would then go for the neuroma surgery. In maybe three instances, I have...
had success with simply drilling a hole in the radial styloid and dissecting proximally and placing this nerve with very little tension into the hole because the whole traction neuritis issue that was brought up earlier. I feel this is a very real phenomenon. I think that is a little bit dependent on how you do this technically. If the nerve is under any tension when it is placed in the bone, any motion across that site will pull on the nerve and traction neuritis will result, causing your neuroma procedure to fail. If you place the finger in full extension for instance and you very gingerly put the nerve in and you have a lot of laxity there still, then I think it will only become more lax as you flex the finger – same situation with the radial sensory nerve at the wrist. So, I think that traction neuritis problems are avoidable through technical efforts.

Warren: Jeff, any additional thoughts on that?

...my favorite technique is to relocate the entire nerve into the mid forearm, unless it is a simple, isolated branch neuroma that is from a small laceration and then I would try a conduit.

- Dean Sotereanos, MD

Jeff: The radial sensory nerves injuries that I have treated, at least lately, are associated with zone 9 extensor tendon injuries, so they are a little more proximal. I have tended to repair all of those because I worry that especially with that brachioradialis tendon, at that point that it is just going to be a recipe for scarring. I am also worried that it is going to get stuck to one of those tendon repairs. I think nerve gliding in that proximal forearm is more challenging when compared to the wrist or a digit. So, I have repaired these and I have occasionally used a nerve-wrap on these also. I just have my anecdotal experience to go on, but I think if I can somehow attempt to protect that from the scarring, it seems to help. That is a fairly limited experience.

Warren: Do you do diagnostic blocks on them before to see if that is going to relieve their pain? Or do you base your decision process on history and your clinical exam?

Dean: Generally I do a Tinel’s test and most of them can’t tolerate that test over the nerve. They jump when you simply tap or percuss over the nerve. They usually come with EMG studies that describe radial sensory deficits. So, like I said, I have tried all of the techniques that we have mentioned and at this point in my career, my favorite technique is to relocate the entire nerve into the mid forearm, unless it is a simple, isolated branch neuroma that is from a small laceration and then I would try a conduit. However, if it is intractable pain in someone who has had several operations, I would plan to relocate it.

Warren: Let’s move on to another topic now. Dean, you have a lot of experience with recurrent and persistent carpal tunnel syndrome. These are two different problems, with recurrent being the patient who has had a carpal tunnel release, was better for a period of time and then develops symptoms again as opposed to someone who never had relief of symptoms after their primary operation. How do you manage the person with the persistent carpal tunnel, and then what is your current opinion as to the role for vein wraps or a conduit wrap as opposed to a hypothenar fat flap or something else?

Dean: That is a very, very good question. In someone with persistent carpal tunnel or carpal tunnel syndrome
that does not remit after primary surgery. I assume that this is an incomplete release. In that particular case, I will not do a vein wrap. I will re-release the carpal tunnel. However, I always do something to augment the soft tissue coverage. I almost always use a hypothenar fat flap. I find that is a very easy flap to do and in the past, have used it in any revision carpal tunnel release for a second operation.

Recently, I started wrapping the nerve with porcine submucosa wrap and sometimes I do both. I will do both to create a belt and suspenders effect. That has worked out pretty well. I would not advise simply to do a revision carpal tunnel release because of the risk of recurrent scaring following the second operation. In your scenario regarding recurrent carpal tunnel syndrome, or someone who was better for a while and then had recurrent symptoms, I would treat that patient the same way. I would probably start with the hypothenar fat flap and maybe augment with the porcine submucosal wrap.

Someone who has had two previous operations, however, is a different story. In this patient, my assumption is now that they have had a good release already. The second operation certainly has released the transverse carpal ligament, and in this case, I would tend to do a vein wrap, as well as an additional hypothenar fat flap just to add a layer of tissue under the skin. It more or less desensitizes that area because of the padding from the thickness of the fat flap. So, the vein wrap would be in someone who has failed two previous surgeries. The hypothenar fat flap and/or the porcine submucosal wrap in someone who has failed one previous surgery.

Warren: Have you ever use collagen or other type of conduit as a wrap, perhaps even in the first revision before the porcine wraps were available?

Dean: The conduit, or collagen tubes that are used for nerve repair are exactly the same material as the wrap that is made commercially, so you could get a tube and basically cut the tube and wrap it around the nerve, or you could use one of their commercially available wraps. So, that is an option, along with the porcine submucosal wrap, but I would still use a hypothenar fat flap in a primary setting and the nerve wrap in addition, but not in place of the fat flap.

Warren: Okay, well, Jeff, Jonathan, or Rob, do you have any additional thoughts or approaches to either persistent or recurrent carpal tunnel syndrome?

Rob: I couldn’t have said it better. That pretty much is exactly my algorithm and almost universally when I have somebody that did not get better from a prior carpal tunnel release it is because the surgeon didn’t feel comfortable dissecting distally to the level of superficial arch and on revision surgery there was persistent compression in this area. There is a 14-millimeter variability in the location of the superficial palmar arch within the palm. There may exist a subset of surgeons that don’t want to dissect around it which may result in incomplete releases. I also always perform a hypothenar fat flap during revisions. Only with the second revision do I use a vein wrap. I have also done this with the ulnar nerve, but that is not as common of a procedure in my practice. In addition during revision carpal tunnel surgery, I try to debulk the carpal tunnel by removing the inflammatory tissue around flexor tendons and I have had good success with that algorithm - basically Dean’s algorithm.

Jonathan: We have been using ultrasound to try to look at the nerve to see if we see areas of ongoing compression. As we know, nerve conduction studies are difficult to interpret following nerve decompression as they likely do not return to normal, so we have started incorporating ultrasound as a new and exiting diagnostic tool. In some situations, particularly with injuries or compression of the nerves around the elbow, ultrasound has been very helpful.

I like to have a staged plan when we go to the OR, so depending on what I find, it may be procedure A, B, or C. One maneuver I find useful during the clinical exam is simultaneous extension of the wrist and fingers. If the patient has a sharp increase in pain when I do the maneuver, I feel it is a traction neuritis and I anticipate I am going to find a lot of scar tissue around the nerve. In that scenario, I generally do a vein wrap. I have found that the vein wrap procedure works very well, but of course it has the morbidity of vein harvest. If I encounter a lot of scar, I will do a vein wrap even if it is the first revision and I have the patient prepared for this. If I look at the nerve and it doesn’t look like there is that much scar, I agree with putting some sort of interposition but in that situation I am not sure it is worth the morbidity of the fat flap, so I use an off the shelf product – either a conduit or nerve wrap. I only use the hypothenar fat flap if it seems like there is a lack of tissue between the nerve and the skin. So, if there is plenty of fat between the skin and the nerve, I only use the wrap.

Warren: I find the median nerve is often adherent to the deep surface of the radial leaf of the transverse carpal ligament, and I find that the hypothenar fat flap can be released and if you suture it to the floor along the radial aspect of the carpal tunnel, it provides
I would say the caveat of my experience has been that ulnar nerve decompressions that fail have been related to subluxation over the medial epicondyle, and I have done a subcutaneous transposition for those and they have been happy with the results. So, like Jonathan, I tend to have a plan A, B, and C and I tend to like to keep the submuscular transposition in my back pocket if I can’t make the subcutaneous transposition work.  

- Dr. Friedrich
sub-q location of the nerve, but in general, I have not seen that as an issue. I know that many surgeons do submuscular transpositions with great results, but to me you are taking the nerve and putting it against a hard surface—the elbow joint and surrounding ligaments. I have not been doing the medial epicondylectomy. One additional thing you have to be careful about is the potential problem of kinking as the nerve shifts directions and crosses the elbow joint or when it goes into the flexor carpi ulnaris—whether it is subcutaneous or submuscular, so you have to be very careful.

Warren: I think that a straight pathway for the nerve may be more important than whether it is in a submuscular or subcutaneous position, so I agree with that. Rob, were you going to say something?

Rob: What I do is actually a sub-fascial transposition. So, that is sort of the in between, as Susan MacKinnon has described. You make that step cut in the fascia and then create a trough for the nerve. As the years have gone on, I have made a more and more generous trough to really create that almost perfect straight line for the ulnar nerve and I have been very aggressive in making sure there is no kinking. So, I will go as far distal as necessary to make sure there are no fascial bands within the flexor carpi ulnaris muscle.

I personally don’t really like the subcutaneous position as much, but my partner does and he is very happy with that. I have revised a couple of those in thin and younger people that were symptomatic and I have done this sub-fascial transposition. I think it has a relatively vascular bed and yet, if it fails, it is not quite the submuscular position where it is in such a deep location that it is very difficult to expose. So, I think I have been a hybrid. One of the issues I have is whether to do an in situ decompression for the primary procedure or to do a transposition. I do the in situ decompression and flex the elbow intraoperatively and see what the ulnar nerve wants to do. If it subluxes a little bit, I will leave it, but if it subluxes more than I am comfortable with, and particularly if the patient is relatively young, then I will have a very low threshold to transpose the nerve. If it is rock solid, then I generally tend to keep the nerve in place, particularly if the nerve is horribly compromised. If there is very slow conduction across the elbow, for example 23 meters per second, then I will try not to disrupt the blood supply. I will try to avoid moving the nerve and try to keep it in place.

Warren: Okay, we have covered all the points that I was hoping to cover tonight.

I appreciate everybody taking their time out of their schedule to participate in this valuable and educational panel discussion.
Middle Phalangeal Fractures: Early Mobilization with Splinting

Shrikant J. Chinchalkar, OTR, CHT, Chelsea A. Barker, MScOT, , Joey G. Pipicelli, MScOT, CHT
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Middle phalangeal shaft fractures account for 10-15% of all fractures in the hand. The management of volar and dorsal lip fractures has been well documented in the literature; however, literature on shaft fractures of the middle phalanx is limited.

The anatomy of the middle phalanx consists of the extensor digitorum communis, central slip and conjoined lateral bands. The conjoined lateral bands are held dorsally by the triangular ligament. These bands reunite across the middle phalanx before inserting onto the base of the distal phalanx forming the terminal tendon. On the volar surface, the flexor digitorum superficialis (FDS) and flexor digitorum profundus (FDP) are intimately aligned. At the proximal phalanx, the FDS divides to pass around the FDP and inserts onto the shaft of the middle phalanx. The transverse retinacular ligament attaches to the conjoined lateral bands volarly. The spiral oblique retinacular ligament arises from the proximal phalanx and inserts onto the distal phalanx, volarly crossing the PIP joint.

Shaft fractures of the middle phalanx are relatively slower to heal because of the vascularity of the cortical bone. Clinical management is dependent upon fracture classification. An undisplaced fracture typically entails closed reduction and immobilization, whereas a displaced fracture requires open reduction and internal fixation (ORIF) with immobilization.

Complications associated with shaft fractures of the middle phalanx have not been well described. In our experience immobilization has lead to tendon adhesions as well as PIP and DIP joint (continued on next page)

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Jeffrey B. Friedrich, MD, Active Membership Committee Chair
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stiffness. Other complications identified included quadriga and lumbrical plus sign. Considering the anatomical location of tendons and ligaments, these complications have compromised functional use of the hand by reducing grip and pinch strength.

Besides protecting the fracture, it is imperative that a controlled mobilization program is implemented to restore digital motion and tendon gliding. To protect the fracture, a volar finger gutter orthosis is fabricated for continual wear (Figure 1). Mobilization orthoses are used to allow PIP and DIP motion respectively. These orthoses consist of a volar finger orthotic stabilizing the proximal and middle phalanx, leaving the DIP free for motion (Figure 2); and a circumferential orthotic stabilizing the distal and middle phalanx allowing PIP motion (Figure 3). It is recommended that patients perform 10-15 repetitions, several times during the day. Upon radiographic confirmation of fracture healing, the frequency of exercises may be increased. Standard edema and pain control measures are used as necessary. Finally, contracture control consisting of flexion or extension orthotics may be utilized once the fracture healing is confirmed. Figure four (Figure-4 a & b) and five demonstrates middle phalanx fracture and final digital flexion following the management as described above (Figure 5).

As mentioned, literature discussing the clinical management for shaft fractures of the middle phalanx is currently limited. A greater emphasis is placed on proximal phalangeal fracture management and complications. This article presents a controlled mobilization guideline to minimize the complications commonly associated with middle phalangeal fractures.

References


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