



# PM&R Update

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## Q & A With Christopher H. Evans, Ph.D.

Director, Mayo Clinic Rehabilitation Medicine Research Center (RMRC)

**Q: What areas of research will the center focus on?**

**A:** Centerwide programs will focus on three key areas: *assistive and restorative technology, functional outcomes, and regenerative medicine*. Clinical research will be aligned with three clinical themes, each with multiple corresponding disease-oriented foci: *neurological, musculoskeletal and medical rehabilitation*. Much of what we do is geared toward developing new clinical modalities that will change the way people are treated in the clinic. As part of this, there will be an emphasis on translational research and clinical trials.

We are trying to amplify those areas of

excellence where we think Mayo researchers already have the kernel of success and launch new ones where we think it's the way of the future. A good example among many includes Mayo's concentration of expertise in spinal cord injury. That's something we definitely want to grow and develop even further. Telemedicine is another area where we will continue devoting some resources, as we have a bedrock of expertise, highly experienced staff and some funding with which to do that.

**Q: Let's focus on regenerative medicine. What are the center's goals for this area?**

**A:** We have fairly ambitious goals for the emerging area of regenerative rehabilitation. And we aim to be one of the leading centers, building upon Mayo's existing strength in regenerative medicine.

**Q: What types of regenerative medicine applications are Mayo researchers currently exploring?**

**A:** My own research interest in this area is in finding new ways to regrow bone, cartilage, ligament and other musculoskeletal tissues so we can replace or regenerate them after injury or disease. This is particularly applicable to treating patients with war injuries. Because of improvements in the efficiency of body armor, warriors are coming home from the battlefield with terrible wounds to the arms and legs, with massive loss of bone, muscle, and skin, and other tissue.

We also see potential for advances in treating patients with degenerative diseases such as osteoarthritis, where we might be able

### Mayo Rehabilitation Medicine Research Center

Centerwide Programs	Assistive and Restorative Technology		
	Functional Outcomes		
	Regenerative Rehabilitation		
Clinical Themes	Neurological Rehabilitation	Musculoskeletal Rehabilitation	Medical Rehabilitation
Disease-Oriented Groups	Neurodegenerative	Spine & Osteoporosis	Cancer
	Brain (TBI, Stroke)	Ultrasound Imaging & Sports	Heart-Lung-Blood
	Spinal Cord Injury	Arthritis	Pediatric
		Bone	Aging
		Soft Tissue	



Christopher H. Evans, Ph.D.

to regenerate missing cartilage, and at the same time control the disease so we can help restore function.

Because bad backs are a huge drain on individuals and the economy, degenerative disk disease is another area of interest. We hope to find ways to regenerate the disk, to relieve pain and restore function. One Mayo research team has a small grant to study this in an animal model using adipose-derived stem cells. There is no reason that this research shouldn't move forward expeditiously.

Nerve and cardiac regeneration are other important applications where Mayo researchers are already world leaders. Our center hopes to synergize with these activities in the context of rehabilitation.

**Q: Are there any clinical trials related to musculoskeletal planned or in progress?**

**A:** We are trying to get a gene therapy trial organized for osteoarthritis and hope that we can begin bringing that to the first patients within the next year. Another trial will evaluate the ability of intra-articular steroids to prevent the onset of post-traumatic osteoarthritis. We

also hope to begin using stem cell approaches to regenerating tissues, including disks, cartilage and bone. Some of these stem cells may also be of value in treating the disease process of osteoarthritis, and we hope to start a clinical trial there.

**Q: How are the areas of aging research and regenerative medicine research intersecting at Mayo right now?**

**A:** The RMRC is working closely with several other strategic initiatives and research centers at Mayo Clinic, including the Robert and Arlene Kogod Center on Aging. One of our center's areas of focus is the aging of muscle, which leads to sarcopenia and frailty. We currently have researchers studying several aspects of aging, including the use of novel drug and physical therapy approaches to help restore or replenish muscle in aging populations. Other areas of intersection lie in the study of osteoarthritis, which is strongly correlated with aging, and spinal cord injury, whose natural history is influenced by aging. I see many fruitful areas of synergy here.

## Stem Cells Studied as Minimally Invasive Treatment for Avascular Necrosis of the Femoral Head



**Figure 1.** Radiograph showing bilateral flattening and collapse of the femoral head, consistent with late-stage AVN.

Avascular necrosis (AVN) of the femoral head is a devastating joint disease that is newly diagnosed in 20,000 Americans each year at an average age of 38. The disease is characterized by decreased blood flow to the femoral head, which can lead to collapse of the femoral head and subsequent degenerative changes. Collapse of the femoral head is typically accompanied by severe pain, and the disease course rarely regresses (Figure 1).

### Risk factors for AVN

Although the pathophysiology of AVN is not yet well-understood, it is thought to be a multifactorial disease, with patients reporting a history of exposure to one or more risk factors, including trauma to the hip, alcohol abuse, corticosteroid use, hemoglobinopathies, pregnancy, coagulopathies, organ transplant, chemotherapy, caisson disease, HIV and autoimmune conditions.

Some assert that the disease results from a clotting disorder or genetic abnormality that leads to vascular compromise, while others

hypothesize that increased intramedullary pressure in the femoral head leads to decreased blood flow and cell death via a mechanism similar to compartment syndrome following a traumatic injury.

### A new approach to treatment

Options to halt the progression of AVN include core decompression, osteotomy and medical treatments. Results associated with these options have been disappointing, with up to 40 percent of patients progressing to total hip arthroplasty.

Mayo Clinic researchers recently began studying the use of concentrated autologous bone marrow and platelet-rich plasma (PRP) as adjuvants to minimally invasive decompression to treat patients with early-stage AVN. After surgeons decompress the femoral head, adult mesenchymal stem cells obtained from the iliac crest and platelet-rich plasma are injected into the area of osteonecrosis (Figure 2). After this procedure, patients are discharged from the hospital using crutches to assist with ambulation as tolerated for approximately two weeks. In patients who undergo bilateral procedures, crutches are recommended until hip pain subsides.

A Mayo Clinic team recently performed a retrospective analysis of 60 patients who were treated using minimally invasive hip decompression augmented by injections of bone marrow concentrate and platelet-rich plasma. Of the 73 hips receiving this treatment, 16 hips (22 percent) progressed to further stages of osteonecrosis, ultimately requiring total hip replacement. Patients were followed for an average of 17 months. Twenty-five patients underwent unilateral decompression and 24 underwent bilateral decompression. Significant pain relief was reported in 86 percent of patients (n = 60), while the rest of patients reported little or no

pain relief. There were no significant complications in any patient.

“We found that this treatment resulted in significant pain relief and halted the progression of disease in a reasonable amount of patients,” explains Rafael J. Sierra, M.D., an orthopedic surgeon at Mayo Clinic’s campus in Rochester, Minnesota, and principal investigator of the Mayo study.

In conclusion, the combination of hip decompression and injection of mesenchymal stem cells into the necrotic lesion provides satisfactory results in patients with early-stage AVN and can lead to complete resolution of the necrotic lesion in select cases. The procedure is simple, with a low complication rate, and the patients are allowed to bear weight as tolerated, allowing them an early return to function and activities of daily living.

Mayo Clinic physicians and researchers are continuing to refine this procedure. In the future, this approach may give clinicians an effective way to regenerate diseased hip tissue, delaying or eliminating the need for hip replacement in people with osteonecrosis of the hip.



Rafael J. Sierra, M.D.



**Figure 2.** Patient with iliac crest aspirators in place, with bilateral hips prepared for decompression and injection of concentrated bone marrow.

## AJPMR Supplement to Focus on Regenerative Rehabilitation Medicine

For more information about what’s new in regenerative rehabilitation medicine, be sure to watch for the the November 2014 supplement to the *American Journal of Physical Medicine and Rehabilitation*.

Edited by Carmen M. Terzic, M.D., Ph.D., chair of Physical Medicine and Rehabilitation at Mayo Clinic, and Martin K. Childers, D.O., Ph.D., Department of Rehabilitation Medicine, University of Washington, this in-depth look at what’s new in this exciting field

features several state-of-the-art articles, including three contributed by Mayo authors:

- Regenerative Principles Enrich Cardiac Rehabilitation Practice
- Stem Cell for Intervertebral Disk Regeneration – A review
- Intraarticular Platelet-Rich Plasma Injection in the Treatment of Knee Osteoarthritis: Review and Recommendations

*AJPMR* is the official scholarly publication of the Association of Academic Physiatrists (AAP).

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### Arizona

866-629-6362

### Florida

800-634-1417

### Minnesota

800-533-1564

## Resources

[mayoclinic.org/medicalprofs](http://mayoclinic.org/medicalprofs)

Clinical trials, CME, Grand Rounds, scientific videos, and online referrals

## Mayo Staff Present at 2014 ACRM Annual Conference

Several Mayo Clinic staff are presenting at the American College of Rehabilitation Medicine's Annual Conference in October. Presentations that feature Mayo faculty include:

### Regenerative Medicine of Musculoskeletal Tissue: Bone, Cartilage, Disc and Muscle

Mayo Clinic Faculty: Carmen, M. Terzic, M.D., Ph. D.; Christopher H. Evans, Ph.D.; Wenchun Qu, M.D., Ph.D.; Nathan K. Le Brasseur, Ph.D.

### Advanced Symposium on Teaching the International Standards for Neurological Classification of SCI

Mayo Clinic Faculty: Ronald K. Reeves, M.D.

### Emerging Biological Targets for Spinal Cord Repair and Regenerative Rehabilitation

Mayo Clinic Faculty: Isobel A. Scarisbrick, Ph.D.

### New Trends in the Care and Rehabilitation of Chronic and Complex Medical Conditions

Mayo Clinic Faculty: Carmen M. Terzic, M.D., Ph.D.; Andrea L. Cheville, M.D.; Kristin D. Zhao, Ph.D.

### Rehabilitation of Medically Complex Liquid Tumor Inpatients: Challenges and Solutions

Mayo Clinic Faculty: Kenley D. Schmidt, M.D.

## Mayo Clinic to Host Rehabilitation Medicine Update at San Juan

Feb. 6-8, 2015, in San Juan, Puerto Rico

Advancements in rehabilitation are accelerating at an unprecedented rate. Physical medicine and rehabilitation professionals need an opportunity to gather and learn about the latest developments. This course is designed as an update of techniques and topics pertaining to physical medicine and rehabilitation that includes: osteoporosis, amputee, ultrasound injection, cancer rehabilitation, brain injury, spinal cord injury, pain, EMG, hand and more.

Course Directors: Carmen M. Terzic, M.D., Ph.D., Chair of Physical Medicine and Rehabilitation, Mayo Clinic, Rochester, Minnesota; Jeffrey S. Brault, D.O., physiatrist, Mayo Clinic, Rochester, Minnesota.

Contact: 800-323-2688 (toll-free) or email [cme@mayo.edu](mailto:cme@mayo.edu)

For more information: [www.mayo.edu/cme/physical-medicine-and-rehabilitation](http://www.mayo.edu/cme/physical-medicine-and-rehabilitation)

## Additional Education Opportunities

### 24th Annual Mayo Clinic Symposium on Sports Medicine

Nov. 7-8, 2014, in Rochester, Minn.

This course is designed to provide the latest diagnostic and treatment strategies for sports-related and musculoskeletal conditions. The program is multidisciplinary, with expert lecturers representing various sports medicine fields. Multiple educational formats are used, including case presentations as well as live demonstrations of physical examination, anatomy and arthroscopy.

Contact: 800-323-2688 (toll-free) or email [cme@mayo.edu](mailto:cme@mayo.edu)

### 9th Annual Mayo Clinic Spine Center: Medical and Surgical Spine Course

Jan. 15-17, 2015, in Phoenix

This three-day course covers current and emerging spine topics driving national change in the quality and delivery of care. Participants from all training backgrounds will learn new skills to survive in the spine care environment of the near future. A unique split curriculum for both nonoperative and procedural specialists delivers Mayo-quality updates via didactics, case presentations, a hands-on examination skills lab, a US-guided injection skill lab and surgical skill labs. Overall, the course provides a rewarding clinical experience for all spine care practitioners, including spine surgeons, medical specialists, primary care providers, and family medicine providers, as well as physical therapists, clinical nurse practitioners, and physician assistants.

Contact: 800-323-2688 (toll-free) or email [cme@mayo.edu](mailto:cme@mayo.edu)

### Mayo Wound Symposium: Basics to Regenerative Medicine

Feb. 19-21, 2015, in Rochester, Minn.

The conference will meet the continuing education needs of wound care providers, from novice to expert, and provide educational sessions and interactive workshops that offer comprehensive wound management strategies. Objectives include: applying the evolving science of wound healing to prevent and manage wounds; evaluating current clinical practice and integrating emerging treatments, technologies, and research data into practice; assessing clinical practice issues that impact positive patient outcomes; and networking to maintain and grow relationships and improve patient care outcomes.

Contact: 800-323-2688 (toll-free) or email [cme@mayo.edu](mailto:cme@mayo.edu)

For more information: [www.mayo.edu/cme/physical-medicine-and-rehabilitation](http://www.mayo.edu/cme/physical-medicine-and-rehabilitation)

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