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CASE REPORT: PREVENTION OF AN ABOVE-KNEE AMPUTATION

Noninvasive emFieldPro HEIT™ and enPuls ESWT success in treating arthrogenic muscular inhibition and patella baja

BY ROD TOMCZAK, MD, DPM, EDD

IN SEPTEMBER 2020, a 72-year-old male underwent a right total knee replacement after an unsuccessful trial of hylan G-F 20. He tolerated the procedure well and progressed in physical therapy (PT). By January 2021, his knee was infected with *Cutibacterium acnes* and required extensive washout and implant replacement. This was followed by six weeks of IV rifampin via a PICC line into the right atrium of the heart.

This regimen was unsuccessful, so the patient underwent removal of the implants, insertion of antibiotic spacers and another PICC line. When joint fluid was synovasure negative and other infection indicators had normalized, the patient was replanted with another permanent total knee. During the gait cycle, the right leg collapsed during the left leg swing phase despite aggressive PT. In September 2023, the surgeon recommended scar tissue debridement and replacement of the tibial plateau acrylic implant. Subsequent to this fifth surgery, the patient returned to PT, strength training the right quadricep and gastrocnemius-soleus complex, which had both severely atrophied. He also tried increasing body weight while supported by a sling from the ceiling. By December 2023, the patient exhibited no discernable increase in ambulatory ability since his first surgery. Over three years, the patient attended 258 PT appointments with little or no improvement. He relied on a recliner and used a wheelchair for mobility. This was the picture of an otherwise healthy 75-year-old. The knee remained flexed at approximately 30 degrees. His surgeon recommended an above-knee amputation with a prosthesis if the patient wished to regain even a modicum of quality of life, noting the amputation would result in a greatly decreased five-year survival rate similar to that of some cancers.

Arthrogenic muscular inhibition and patella baja

The patient then took a more aggressive role in his future, discovering arthrogenic muscular inhibition (AMI).[1] AMI involves inhibition of the vastus medialis obliquus (VMO) muscle and extension deficits due to hamstring contracture, which can lead to patella baja, a condition where the patella is below its normal position, resulting in a hard endpoint when extending the leg.

Degrees of involvement were classified from Grade 0 to Grade 3. Grades 1 and 2 of the condition respond well to exercise, restoring normal extension and muscle strength. In Grade 2b, the VMO must be activated or gains in therapy will be lost once discontinued. Grade 2b requires up to a year of therapy with emphasis on waking up the quadriceps muscles, specifically the VMO, with biofeedback and electrical stimulation. If Grade 2b does not respond to therapy, surgery may be necessary, including posterior arthrolysis of the knee joint capsule and patellar tendon lengthening. These procedures are fraught with risks, including complete rupture of the tendon and knee

1 Freychet B, et al. Arthrogenic muscle inhibition following knee injury or surgery: pathophysiology, classification, and treatment. *Video Journal of Sports Medicine.* 2022;2(3). Sage Journals. https://journals.sagepub.com/doi/10.1177/26350254221086295. Accessed September 30, 2024

7-25-2021: Patient's x-ray showing normal patella position

10-19-2022: Patient's x-ray showing osteoporotic, shrunken patella in baja position

paralysis. Hence, noninvasive therapy modalities are preferable to invasive procedures where complications can easily arise.

The treatment plan

This patient was treated with Zimmer MedizinSystems' emFieldPro high energy inductive therapy (HEIT) device on the quadriceps, specifically on the VMO, four times per week for 20 minutes, increasing contraction intensity as tolerated. Hypertrophy was substantial, gaining almost two inches in size. Circumference was not considered a parameter for success but the study suggested a comparison of the not affected limb to the affected leg.[1] The strength gain was approximately 50% in the four months the patient was treated with the emFieldPro HEIT device. The patient was treated with the device on the contralateral side and included bilateral gastrocnemius-soleus muscles, anticipating a return to normal physical activity.

The patient was considered a stage 3 AMI when he began therapy and by April 2024 was still hitting a rigid endpoint approximately 20 degrees from full extension. He was also treated with the Zimmer MedizinSystems' enPuls extracorporeal shockwave therapy (ESWT) device for the patellar tendon, the posterior knee capsule and biceps femoris tendon, which remained contracted and partially responsible for maintaining a rigid endpoint. In one month, he made remarkable gains in the patella's position. He received enPuls ESWT three times per week alongside emField HEIT. Five months of emFieldPro HEIT and one month of enPuls ESWT resulted in significantly more gains in AMI and patella baja than over three years of conventional PT, including electric nerve stimulation. Evaluation of the VMO muscles bilaterally revealed that the affected limb was only 15% smaller than the unaffected limb and extension was measured to be 12 degrees.

emFieldPro HEIT

emFieldPro HEIT stimulates cellular signaling pathways, translating electromagnetic signals into biological signals at the cellular level. This process stimulates nerves, muscle fibers and blood vessels through growth factors like fibroblast growth factor, vascular endothelial growth factor and bone morphogenetic proteins. HEIT also stimulates the release of endorphins, reducing pain perception and restoring the normal resting potential of cell membranes, which normalizes electrolyte exchange and supports cellular functions, including energy production by mitochondria.[2,3] This therapy has shown impressive results for muscle stimulation and strengthening in deep tissues due to its high frequency and magnetic energy levels, which conventional PEMF units cannot achieve.[4]

enPulsPro ESWT

enPulsPro ESWT uses shockwaves to induce microtrauma, promoting neovascularization and healing through the recruitment of stem cells and the release of growth factors. ESWT improves skin elasticity, increases collagen production and breaks up fibrous bands, releasing tissue. The mechanical energy from the shockwaves transforms into a biological response through mechano-transduction, activating cellular structures and stimulating proteins essential for the healing process.[5]

Conclusion

Early recognition of AMI and timely treatment with Zimmer MedizinSystems' noninvasive emFieldPro HEIT and enPuls ESWT modalities can help avoid contracture of the patellar tendon. This reduces the chances of the condition progressing to a stage where amputation is necessary, significantly improving outcomes.

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2 Stratton S. Role of endorphins in pain modulation. *The Journal of Orthopaedic and Sports Physical Therapy.* 1982;3(4):200-205. PubMed. https://pubmed.ncbi.nlm.nih.gov/18810127/. Accessed September 30, 2024

3 Clement-Jones V, et al. Increased beta-endorphin but not met-enkephalin levels in human cerebrospinal fluid after acupuncture for recurrent pain. *The Lancet.* 1980;316(8190):946-948. PubMed. https://pubmed.ncbi.nlm.nih.gov/6107591/. Accessed September 30, 2024

4 Paolucci T, et al. Electromagnetic field therapy: A rehabilitative perspective in the management of musculoskeletal pain: A systematic review. *Journal of Pain Research.* 2020;13:1385-1400. PubMed. https://pubmed.ncbi.nlm.nih.gov/32606905/. Accessed September 30, 2024

5 Vinzenz A, Klemens T. Extracorporeal shock wave therapy: an update. *EFORT Open Reviews.* 2020;5(10):584-592. PubMed. https://pubmed.ncbi.nlm.nih.gov/33204500/. Accessed September 30, 2024