

Clinical Commentary/Current Concept Review

TECAR Therapy: A Clinical Commentary on its Evolution, Application, and Future in Rehabilitation

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Background

TECAR (Transfer of Energy Capacitive and Resistive) therapy is a novel electrotherapy modality gaining traction in orthopedic and sports rehabilitation. This technique utilizes radiofrequency energy to promote tissue healing, pain management, and functional recovery, offering a unique approach to address musculoskeletal injuries and conditions.

Purpose

The purpose of this clinical commentary is to delve into the current body of literature on TECAR therapy, meticulously examining both its strengths and the gaps that remain.

Methods

A comprehensive literature review was conducted, focusing on the evolving role of TECAR therapy in managing various orthopedic and sports-related injuries. Key studies, including randomized controlled trials and meta-analyses, were evaluated to assess the effectiveness of TECAR therapy in pain reduction, tissue repair, and enhancement of athletic performance.

Results

Current evidence suggests that TECAR therapy may effectively reduce pain, improve range of motion, and facilitate tissue regeneration. Notably, it has shown promise in treating conditions such as tendonitis, ligament sprains, and spasticity in stroke survivors. Furthermore, studies indicate that TECAR therapy can enhance biomechanical parameters and running economy, potentially leading to improved athletic performance. Limitations in the current research such as small sample sizes, lack of long-term efficacy studies, and variability in treatment protocols hinder definitive conclusions regarding its clinical utility.

Discussion

The authors suggest that integration of TECAR therapy into rehabilitation programs presents opportunities for optimizing patient outcomes and enhancing athletic performance. By incorporating TECAR, athletes may experience faster recovery times, reduced injury risk, and improved performance metrics, making it a potentially valuable addition to sports rehabilitation strategies. Future research should focus on standardizing treatment protocols, exploring long-term effects, and assessing cost-effectiveness to enhance accessibility and implementation in diverse clinical

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settings. Additionally, mechanistic studies are essential for elucidating the underlying biological processes that contribute to TECAR's therapeutic effects.

Conclusion

TECAR therapy represents a promising yet underexplored modality in rehabilitation. As evidence accumulates, its integration into standard clinical practice could revolutionize approaches to pain management and recovery in patients, especially athletes. Continued exploration and validation of TECAR therapy will advance the field of sports physical therapy, unlocking new possibilities for enhancing rehabilitation outcomes and athletic performance.

Level of Evidence

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INTRODUCTION

In the ever-evolving landscape of rehabilitation, Transfer of Energy Capacitive and Resistive (TECAR) therapy emerges as a groundbreaking innovation, capturing the attention of both practitioners and researchers. Unlike traditional therapeutic modalities such as ultrasound, electrical stimulation, and cryotherapy, which have long been embedded in the fabric of orthopedic and sports physical therapy, TECAR therapy represents a novel approach that is quickly gaining traction. Its relatively recent introduction into the market and the limited scope of scientific research have created an aura of curiosity and excitement around its potential benefits.

The rise of TECAR therapy coincides with a broader debate within the field regarding the efficacy and role of various biophysical agents. For years, modalities like ultrasound and electrical stimulation have been integral components of rehabilitation protocols. Yet, these treatments have also faced skepticism and criticism, with some detractors dismissing them as “sham” therapies or questioning their clinical value. This skepticism often stems from inconsistent results in clinical studies and the perception that these modalities serve more as revenue-generating tools than effective therapeutic interventions. Despite these controversies, authoritative bodies such as the American Physical Therapy Association (APTA) and numerous clinical practice guidelines persist in acknowledging the role of biophysical agents, highlighting their potential as adjunctive treatments in musculoskeletal rehabilitation.

The importance of this nuanced perspective is underscored by recent discussions in the literature, which emphasize that modalities should not be viewed as standalone solutions but rather as supportive elements that enhance the overall therapeutic regimen. According to Page,¹ the value of biophysical agents lies in their ability to provide short-term pain relief and facilitate exercise, thereby reducing the reliance on pharmacologic treatments and enabling effective rehabilitation.

In the highly competitive world of sports, where outcomes can be decided by extremely small margins, any improvement in an athlete's condition can make the difference between winning and losing. This reality has prompted many professional sports organizations to incorporate TECAR therapy into their rehabilitation methodolo-

gies. While the scientific evidence supporting TECAR is not yet overwhelmingly robust, there is a growing body of research suggesting notable improvements in performance and recovery. This potential for enhancing athletic performance and expediting recovery from injuries has made TECAR therapy an appealing option for teams and athletes striving for a competitive edge.

Amidst this backdrop, TECAR therapy stands out as a promising yet underexplored modality. Its mechanism of action—utilizing both capacitive and resistive energy transfer—suggests a novel approach to addressing musculoskeletal injuries and pain. While preliminary studies and clinical applications hint at its potential advantages, such as improved tissue healing and pain relief, a comprehensive evaluation of the existing research is necessary to fully understand the role of TECAR therapy in rehabilitation.

Therefore, the purpose of this clinical commentary is to delve into the current body of literature on TECAR therapy, meticulously examining both its strengths and the gaps that remain. By analyzing available evidence, the authors aim to shed light on the clinical applications of TECAR therapy, exploring its effectiveness across a spectrum of conditions and evaluating how it compares to more established modalities. Additionally, this commentary seeks to identify areas for future research, advocating for more rigorous and targeted studies that could solidify TECAR therapy's place in rehabilitation practice. Through this comprehensive review, the authors hope to contribute valuable insights that will guide practitioners in making informed decisions about incorporating TECAR therapy into their treatment protocols and advancing the field of orthopedic and sports physical therapy.

SCIENTIFIC FOUNDATION

The origins of TECAR therapy, a contemporary modality gaining prominence in sports medicine and orthopedic rehabilitation, can be traced back to the foundational work on high-frequency electric currents in medical applications. The initial groundwork was laid by Jacques Arsène d'Arsonval, a distinguished French physician and physicist, who in 1890 identified the therapeutic potential of electric currents exceeding 100 kHz. D'Arsonval's pioneering research demonstrated that such frequencies could significantly en-

hance the permeability of plasma membranes, thereby introducing new possibilities for medical treatment.

Building upon these early findings, the field of diathermy—defined as the use of high-frequency electric currents to generate heat within body tissues—began to take shape. In 1939, English physician and physicist William Beaumont further advanced this concept by exploring the therapeutic applications of diathermy. Beaumont's work employed both capacitive and resistive methods, utilizing frequencies around 500 kHz, to create some of the earliest physiotherapy equipment. His contributions were instrumental in establishing the foundation for the development of modern physiotherapeutic modalities, including TECAR therapy, which continues to evolve and find new applications in clinical practice today.

TECAR therapy is an innovative modality used in physical therapy and rehabilitation. Its scientific foundation is based on the principles of electromagnetic energy transfer, which includes two primary mechanisms: capacitive and resistive energy transfer. TECAR therapy operates using radiofrequency energy, typically within the range of 300 kHz to 1.2 MHz. This energy penetrates biological tissues, leading to molecular agitation and heat generation. The therapy is applied through two distinct modes: capacitive energy transfer (CET) and resistive energy transfer (RET). Capacitive energy transfer uses an insulated electrode to create an electric field between the electrode and the patient's skin, targeting tissues with high water content like muscles and subcutaneous tissues. The dielectric properties of the electrode allow selective heating, primarily in the soft tissues and fluids around the electrode. This localized heating promotes vasodilation, increases blood flow, and enhances metabolic activity, leading to improved tissue elasticity, reduced muscle tension, and effective removal of metabolic waste products. In contrast, resistive energy transfer targets deeper tissues with higher resistance, such as bones, tendons, and ligaments, using a non-insulated electrode. This mode allows for deeper penetration of energy, facilitating heat generation in dense structures, thus promoting collagen synthesis, tissue regeneration, and reducing inflammation.²⁻⁴

Apart from its heating effects, TECAR therapy induces bioelectrical effects by influencing ion exchange within cells, potentially affecting membrane potentials and enhancing cellular function. This can stimulate cellular metabolism, promoting repair and regeneration at the cellular level, and modulating the release of pro-inflammatory cytokines, thereby reducing inflammation and facilitating recovery.^{2,5,6} The thermotherapy benefits of TECAR therapy include increased blood flow due to vasodilation, leading to delivery of oxygen and nutrients for tissue repair, and pain reduction by decreasing muscle spasms and inhibiting pain receptors.⁷ Furthermore, TECAR therapy has been suggested to support lymphatic drainage, potentially aiding in the reduction of edema and swelling in affected tissues. Although the primary effects of TECAR therapy are electromagnetic, it also has mechanical effects due to the induced micro-vibrations that can aid in the healing process. This combination of electromagnetic, bioelectrical, and me-

chanical effects makes TECAR therapy a versatile tool in modern rehabilitation practices, offering a comprehensive approach to healing and recovery.^{2,8,9}

CONTRAINDICATIONS FOR TECAR THERAPY

While TECAR therapy is generally considered safe and effective, certain contraindications must be observed to ensure patient safety. TECAR therapy is contraindicated during pregnancy, particularly in the abdominal and pelvic regions, due to the potential risk of affecting fetal development.¹⁰ Patients with pacemakers or other implanted electronic devices should avoid TECAR therapy, as the electromagnetic fields may interfere with the function of these devices.¹¹ Additionally, TECAR therapy should not be applied over malignant tumors or cancerous areas due to the risk of promoting cell growth and proliferation.¹² Active infections, especially in the treatment area, are contraindicated as the therapy may exacerbate the infection.¹³ Similarly, TECAR therapy should be avoided in patients with thrombophlebitis or deep vein thrombosis (DVT), as the increased circulation might dislodge a thrombus, leading to serious complications.¹⁰ Patients with severe cardiovascular disorders may not tolerate the changes in blood flow and vascular dynamics induced by TECAR therapy.¹⁴ Furthermore, individuals with sensitivity or allergies to electromagnetic fields should avoid TECAR therapy as it may lead to adverse skin reactions or discomfort.⁶ By considering these contraindications, clinicians can minimize risks and enhance the safety and effectiveness of TECAR therapy for their patients.

PAIN MANAGEMENT

TECAR therapy has been explored as a potential tool in the management of both acute and chronic pain conditions, with applications in sports medicine and physical therapy. Ganzit et al.¹⁵ reported on TECAR therapy application to 327 patients aged 18 to 60, including 68 acute and 259 chronic cases. Patients underwent a treatment regimen of 10 minutes of Resistive Electric Transfer (RET) and 10 minutes of Capacitive Electric Transfer (CET). While the study outcomes indicated improvements in pain scores as measured by the Visual Analogue Scale (VAS), it is important to note that the absence of a control group and other study limitations reduce the level of evidence and thus the applicability of these results. Additionally, Ganzit et al. emphasized that TECAR therapy outcomes overlap with those observed in traditional interventions, necessitating further research to determine its distinct clinical utility.

A proposed study conducted by Raeisi et al.¹⁶ focused on patients with adhesive capsulitis, a condition characterized by shoulder pain and stiffness. This protocol study involved 30 patients aged 41 to 72, all experiencing pain and stiffness for at least three months, with significant restriction of passive range of motion (PROM) in the glenohumeral external rotation. The intervention group received TECAR therapy alongside conventional physical therapy, including exercises such as wall climbs, pendulum exercises, and var-

ious stretches. While the protocol outlined potential improvements in shoulder range of motion and decreased disability as measured by the Shoulder Pain and Disability Index (SPADI), it is important to note that this was a only a protocol and not a completed randomized controlled trial. Further research and completed trials are required to substantiate the proposed benefits of TECAR therapy in managing shoulder pain and stiffness.

Additionally, in a literature review by Ribeiro et al.¹⁷ TECAR therapy's impact on various musculoskeletal disorders, including low back pain (LBP), femur fractures, and rotator cuff (RTC) tendinopathies was examined. The review encompassed six studies, demonstrating that TECAR therapy consistently reduced pain scores via VAS and improved functional outcomes, such as the Oswestry Disability Index (ODI) for low back pain and the Simple Shoulder Test for rotator cuff tendinopathies. Paolucci et al.¹⁸ further supported these findings with a study on patients with painful shoulder impingement syndrome, revealing significant reductions in VAS scores from 7.23 ± 1.11 to 2.68 ± 0.99 and improvements in qDASH and Constant-Murley Scale (CMS) scores, confirming TECAR therapy's potential for reducing shoulder pain and enhancing function.

SPORTS PERFORMANCE

Canet-Vintró et al. investigated the incorporation of TECAR therapy into a warm-up routine involving active muscle contractions and the results indicated that this intervention may enhance baseline physiological conditions of the muscle before a 30-meter sprint test. This intervention may also lead to measurable improvements in muscle strength compared to the athlete's baseline state prior to both the warm-up and TECAR therapy. Observations included slight improvements in sprint performance, vertical jump height, and quadriceps strength, suggesting a potential 1% enhancement in overall performance.¹⁹ While a 1% improvement might seem minimal, in competitive sports where outcomes are often decided by small margins, even slight gains could significantly impact performance and outcomes.

These results underscore the potential of TECAR intervention to positively impact muscle function and performance, particularly in activities requiring explosive power, such as sprinting. However, it is important to note that TECAR therapy should not be viewed as a standalone modality. The study emphasized that the observed benefits were optimized when TECAR was combined with targeted exercise routines rather than applied in isolation.

In a single-blind clinical trial conducted by Davari et al.²⁰ the effects of TECAR therapy on acute symptoms of athletes following lateral ankle ligament sprain were evaluated. The study included 23 athletes, with assessments conducted using various parameters, including Visual Analog Scale (VAS) scores, swelling, and performance status. Results indicated no statistically significant difference in mean VAS scores or swelling between the treatment and control groups. Both groups exhibited improvements in VAS, swelling, and Foot and Ankle Ability Measure (FAAM)

scores over the course of treatment. Improvements in performance status were noted in both groups, although these were not statistically significantly different. These findings suggest that TECAR therapy may support the management of acute symptoms in lateral ankle ligament sprains, particularly in addressing pain, swelling, and functional status – critical elements in the early treatment of athletic injuries.

Beyond its pain management capabilities, TECAR therapy has demonstrated potential in enhancing athletic performance by improving biomechanical parameters. Dunabeitia²¹ evaluated TECAR therapy's effects on recreational runners and reported improvements in running economy, stride length, stride angle, and stride frequency. While no significant physiological changes were observed, the results suggest that TECAR therapy might optimize biomechanics, potentially improving sports performance. The findings highlight TECAR therapy's potential as an adjunctive treatment for athletes aiming to refine running mechanics and efficiency.

In a randomized controlled crossover trial conducted by Dunabeitia²¹ the effects of TECAR therapy on physiological and biomechanical parameters in recreational runners were further explored. The study involved a training session followed by treadmill tests before and after a 50-minute TECAR therapy session, with a 48-hour rest period between tests. TECAR therapy consisted of capacitive electric transfer (CET) for 10 minutes, resistive electric transfer (RET) for 15 minutes per lower extremity, and another session of CET for 10 minutes. While no significant changes in physiological parameters were noted, improvements were observed in running economy, step length, stride angle recovery, stride height recovery, and decreased stride frequency after TECAR therapy. The discussion suggested that improved running economy could enhance sports performance; however, limitations such as the lack of a sham treatment comparison and the absence of long-term running performance outcomes were acknowledged. The results indicate potential biomechanical benefits for recreational runners, though further research is needed to confirm these findings.

Considering these results, the utilization of TECAR therapy in sports and rehabilitation settings requires further exploration to better understand its effects across diverse athletic and clinical populations. As more professional sports organizations increasingly adopt TECAR technology in their rehabilitation protocols, evaluating its full potential and limitations will be critical for optimizing athlete care and performance outcomes.

TISSUE REPAIR AND HEALING

TECAR therapy's ability to increase hemoglobin saturation and tissue temperature further supports its role in tissue repair and healing. Tashiro et al.² investigated these effects, demonstrating that TECAR therapy significantly increased both total and oxyhemoglobin levels and raised tissue temperature more effectively than hot packs and sham treatments. This thermal effect, observed at both superficial and deeper tissue levels, is proposed to enhance muscle

fatigue recovery, tissue repair, and wound healing, making TECAR therapy a valuable modality for rehabilitation and recovery. These findings underscore TECAR therapy's potential in facilitating faster recovery from musculoskeletal injuries and promoting tissue health.

FIBROSIS TREATMENT AND ANTI-INFLAMMATORY EFFECTS

In addition to its role in pain management and performance enhancement, TECAR therapy has demonstrated potential anti-fibrotic effects that may benefit patients with fibrotic pathologies. A recent study explored the effects of Capacitive Resistive Electric Transfer (CRET) therapy on cultures of human myofibroblasts, revealing significant reductions in extracellular matrix production, including decreases in collagen types I and III. The study found a 20% reduction in α -SMA expression and a decrease in collagen type I by 23% and collagen type III by 16% over controls.²²

CRET therapy also appeared to influence cell proliferation and apoptosis, with myofibroblasts treated for 48 hours showing a 4% reduction in proliferation compared to controls. While this reduction was statistically significant, the therapy also decreased the number of apoptotic cells, suggesting a protective effect on cell survival. The study further analyzed the impact on cell migration, where no statistically significant changes were observed in myofibroblast migration rates compared to controls. However, notable changes were detected in the expression of metalloproteinases, particularly MMP9, which increased by 63% after 24 hours of CRET treatment. This increase could facilitate the degradation of collagen I and III, promoting the reduction of fibrosis.

Moreover, CRET therapy was shown to affect the activation of NF-kappa B, a pro-inflammatory transcription factor. The expression of p-NFkB decreased significantly at 12 and 24 hours post-treatment, indicating an anti-inflammatory effect that could further benefit fibrotic conditions. These findings suggest that CRET therapy may offer a novel approach for managing fibrosis by modulating extracellular matrix production, influencing metalloproteinase activity, and reducing inflammation, potentially broadening the therapeutic applications of TECAR therapy in clinical settings.

SPASTICITY REDUCTION AND RANGE OF MOTION IMPROVEMENTS

TECAR therapy has shown potential in reducing muscle spasticity and improving the range of motion in patients with neurological conditions. In a double-blind randomized controlled trial conducted by García-Rueda et al., 36 chronic stroke survivors with lower limb hypertonia were treated with a single 30-minute session of TECAR therapy combined with functional massage on the gastrocnemius and quadriceps muscles.²³

The primary outcome, measured using the Modified Ashworth Scale (MAS), indicated a significant decrease in

spasticity for ankle dorsiflexion immediately after treatment and maintained improvement 30 minutes post-treatment. Additionally, secondary outcomes demonstrated significant enhancements in the passive range of motion for knee flexion and ankle dorsiflexion. These findings suggest that TECAR therapy, when used alongside massage, can effectively reduce muscle tone and increase flexibility in chronic stroke survivors, offering a promising therapeutic option for improving mobility in this population.

LIMITATIONS

Despite the promising findings associated with TECAR therapy, there are several limitations in the current literature that must be addressed to fully investigate clinical efficacy. One of the primary limitations is the lack of large-scale randomized controlled trials (RCTs) with adequate sample sizes. Many studies on TECAR therapy, such as those focusing on running economy and ankle sprains, often involve small participant groups, limiting the statistical power and generalizability of the results to larger populations. For instance, Dunabeitia's study on recreational runners included a relatively small cohort, which might not accurately represent the broader athletic community. Similarly, the study by García-Rueda et al. on stroke survivors also involved a limited number of participants, which could affect the robustness of the conclusions drawn regarding its effects on muscle tone and spasticity.

Furthermore, there is a noticeable absence of sham-controlled trials in several studies, which raises concerns about the potential for placebo effects. Without a proper placebo group, it becomes challenging to ascertain whether the observed improvements are genuinely attributable to TECAR therapy or merely the result of participants' expectations of treatment benefits. This limitation is evident in studies such as the one by Davari et al., where improvements in pain and functional status were noted without clear differentiation from placebo responses.

Another critical limitation is the heterogeneity in the study protocols regarding treatment parameters, including the duration, intensity, frequency, and specific techniques of TECAR application. This lack of standardization makes it difficult to compare findings across different studies and complicates efforts to establish a universally accepted treatment protocol for TECAR therapy. For example, the studies by Raeisi et al. and Paolucci et al. employed different treatment durations and intensities, potentially leading to varying results and interpretations.

Moreover, the majority of studies focus primarily on short-term outcomes, neglecting to investigate the long-term effects and sustained efficacy of TECAR therapy over extended periods. While immediate improvements in pain, function, and muscle tone are frequently reported, the durability of these effects remains uncertain without longitudinal follow-up. This is particularly crucial for chronic conditions, where long-term management and symptom relief are vital for patient quality of life.

There is also a paucity of mechanistic studies exploring the underlying biological processes that contribute to the

effects of TECAR therapy. Although some research, like the study on the anti-fibrotic effects of TECAR therapy, suggests potential cellular and molecular pathways, such as modulation of metalloproteinase activity and reduction of extracellular matrix production, more comprehensive investigations are needed to elucidate these mechanisms. Understanding these processes is essential for optimizing TECAR therapy and integrating it with other treatment modalities effectively.

Finally, most studies to date have concentrated on specific conditions or populations, limiting the breadth of evidence supporting TECAR therapy's versatility. The current literature predominantly focuses on musculoskeletal disorders, spasticity in stroke survivors, and specific sports injuries. Expanding research to encompass a wider range of pathologies and patient demographics would enhance the understanding of TECAR therapy's potential applications and effectiveness across various clinical settings.

FUTURE IMPLICATIONS AND SUGGESTIONS

The expanding body of research on TECAR therapy reveals its potential to revolutionize orthopedic and sports physical therapy, offering a novel approach to pain management, tissue healing, and functional recovery. However, to fully harness its therapeutic capabilities, several future directions and suggestions can be considered for clinical practice and further research.

1. OPTIMIZING TREATMENT PROTOCOLS

To establish TECAR therapy as a standard practice in orthopedic and sports rehabilitation, it is crucial to standardize treatment protocols across different conditions and populations. This includes identifying the optimal duration, frequency, and intensity of therapy sessions for specific injuries or pathologies. Research should focus on tailoring protocols to address specific orthopedic conditions such as tendonitis, ligament sprains, and muscle strains, which are prevalent in sports contexts. Conducting comparative studies to evaluate TECAR therapy against other established modalities such as ultrasound, laser therapy, and electrical stimulation would provide valuable insights into its relative efficacy and advantages.

2. LONG-TERM EFFICACY STUDIES

While many current studies demonstrate the short-term benefits of TECAR therapy, there is a significant gap in understanding its long-term effects. Longitudinal studies examining the sustained outcomes of TECAR therapy on pain, functional mobility, and recurrence rates of musculoskeletal injuries are necessary. Such research would be particularly beneficial in chronic conditions like osteoarthritis or long-standing sports injuries, where long-term management is crucial. These studies should also investigate whether continued use of TECAR therapy can prevent re-injury or facilitate quicker recovery times in athletes returning to sport after rehabilitation.

3. INTEGRATION WITH ATHLETIC TRAINING PROGRAMS

Given the potential of TECAR therapy to enhance biomechanical parameters and improve running economy, integrating it into athletic training programs could offer performance benefits for athletes. Future studies could explore how TECAR therapy can be incorporated into pre-season conditioning programs or used as a routine part of athletic training regimens. Investigating its role in injury prevention strategies could also be valuable, particularly in high-impact sports where players are at risk of recurrent injuries. Research focusing on how TECAR therapy might complement strength and conditioning exercises, stretching routines, or proprioceptive training could pave the way for comprehensive rehabilitation and performance enhancement protocols.

4. EXPLORING MECHANISTIC INSIGHTS

While TECAR therapy has shown promise in altering cellular and molecular pathways associated with inflammation and fibrosis, further exploration of its mechanistic effects is needed. Understanding the exact biological mechanisms through which TECAR therapy influences tissue repair and regeneration will aid in optimizing its therapeutic application. Studies should focus on the modulation of inflammatory markers, angiogenesis, collagen synthesis, and neural activation to provide a clearer picture of how TECAR therapy promotes healing. These insights could also facilitate the development of targeted therapies for specific injuries or conditions, enhancing the precision and effectiveness of treatment.

5. EXPANDING APPLICATIONS TO DIVERSE POPULATIONS

Most current research on TECAR therapy centers around adult athletes and specific patient populations. Expanding studies to include diverse demographics, such as pediatric and geriatric patients, could open new avenues for its application. Investigating its effects on younger athletes might reveal benefits in growth-related injuries or pediatric orthopedic conditions, while studies on older adults could focus on managing age-related musculoskeletal disorders and enhancing mobility. Furthermore, understanding how TECAR therapy can be adapted for individuals with varying levels of physical activity and different health statuses would broaden its scope and applicability in clinical practice.

6. COMBINATION WITH OTHER MODALITIES

The effectiveness of TECAR therapy might be enhanced when combined with other therapeutic modalities, such as manual therapy, cryotherapy, or resistance training. Future research could investigate synergistic effects by integrating TECAR therapy with other treatments to create holistic rehabilitation protocols. This approach could potentially maximize patient outcomes by addressing multiple facets of recovery simultaneously, including pain reduction, mus-

cle strength, and functional capacity. Clinical trials should aim to determine the most effective combinations of treatments for various injuries and conditions, providing practitioners with evidence-based guidelines for comprehensive patient care.

7. COST-EFFECTIVENESS AND ACCESSIBILITY

Assessing the cost-effectiveness of TECAR therapy compared to traditional rehabilitation methods is an essential step toward its widespread adoption. Future studies should evaluate the economic implications of TECAR therapy, including potential cost savings from reduced recovery times, decreased medication use, and fewer healthcare visits. Additionally, exploring ways to make TECAR therapy more accessible in different healthcare settings, including rural or underserved areas, will be crucial for ensuring that patients across various socio-economic backgrounds can benefit from this advanced therapeutic modality.

8. DEVELOPING CLINICAL GUIDELINES

As the evidence supporting TECAR therapy grows, developing clinical guidelines will be imperative to ensure its safe and effective use. These guidelines should be informed by robust clinical trials and expert consensus, providing practitioners with standardized protocols for application in orthopedic and sports rehabilitation settings. Guidelines could cover indications, contraindications, safety measures, and patient-specific considerations, contributing to the consistent and high-quality delivery of TECAR therapy across clinical practices worldwide.

CONCLUSION

In conclusion, the authors believe that TECAR therapy holds significant promise as an emerging modality in sports medicine and orthopedic rehabilitation. Its potential to alleviate pain, support tissue healing, and enhance athletic performance is compelling, yet the current evidence remains in its early stages, highlighting the need for further rigorous research to confirm its clinical efficacy. As interest in this innovative therapy grows among practitioners and researchers, there is an opportunity to refine its application and incorporate it into holistic treatment protocols. By pursuing well-designed studies to explore and validate TECAR therapy, the field of rehabilitation can unlock new possibilities for improving patient outcomes and advancing the science of physical therapy and sport.

CONFLICT OF INTEREST STATEMENT

Some authors serve as academic consultants for products mentioned within the paper and receive financial compensation for their roles, but this compensation is not connected to the preparation or content of this manuscript.

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