Efficacy of ReBound Diathermy as a Thermal Heating Agent: A Critically Appraised Topic

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Clinical Scenario: ReBound is a portable shortwave diathermy unit used to heat tissues using the same principle as induction drum shortwave diathermy. It is unclear if ReBound can vigorously (4°C) heat intramuscular tissue as efficiently as other thermal agents. **Clinical Question:** In adults (P), is ReBound diathermy (I) compared with other thermal agents (C) effective at increasing intramuscular tissue temperature by 4°C (O)? **Summary of Key Findings:** (1) Three studies were included for review, all randomized crossover studies. (2) All studies agreed ReBound does not achieve vigorous (4°C) heating effects during a 30-minute treatment to the triceps surae muscle (depth = 1 and 3 cm). (3) Studies agreed that the heat generated by ReBound dissipates slower than ($P < .001$) or similar to pulsed shortwave diathermy at 3 cm and faster than moist hot packs ($P < .001$) at 1 cm. (4) One study found that intramuscular tissue temperatures increased more with ReBound (3.69°C [1.50°C]) than moist hot packs (2.82°C [0.90°C]) at superficial depths (1 cm, $d = 0.70$). (5) Two studies compared ReBound with MegaPulse II pulsed shortwave diathermy at a 3 cm depth. One found that the MegaPulse II increased intramuscular tissue temperature by 4.32°C (1.79°C) compared with the ReBound's 2.31°C (0.87°C) increase ($d = 1.43$). The final study reported that the MegaPulse II increased triceps surae muscle temperature by 3.47°C (0.92°C) versus ReBound at 3.08°C (1.19°C) ($d = 0.37$). (6) The combined results are an increase of 3.81 (1.38°C) for the MegaPulse II and 2.77 (1.12°C) for ReBound ($d = 0.83$). **Clinical Bottom Line:** Results strongly indicate that the ReBound should not be used for vigorous (4°C) heating effects in the triceps surae muscle at 1 and 3 cm. Clinicians can use ReBound when traveling or instead of moist hot packs for moderate (2°C – 3°C) heating effects at deep and superficial levels (1 and 3 cm) for large treatment areas with subcutaneous fat thickness <15 mm. **Strength of Recommendation:** Consistent level B findings indicate that ReBound does not achieve vigorous heating effects (4°C).

Keywords: thermotherapy, temperature, diathermy, intramuscular temperature

Clinical Scenario

Heat is used to accelerate the metabolic rate, decrease muscle spasm, decrease pain, increase blood flow, reduce chronic inflammation, and encourage tissue elongation.¹⁻⁴ Modalities used to raise tissue temperature include warm whirlpools, moist hot packs (MHPs), paraffin bath, therapeutic ultrasound, and pulsed shortwave diathermy (PSWD). These modalities can be separated into superficial and deep modalities according to their depth of penetration. Superficial modalities heat tissues 1 cm deep and include MHP, warm whirlpools, and paraffin baths.² Deep modalities heat tissues 3 cm deep and include shortwave diathermy (SWD) and therapeutic ultrasound.² The physiological effects created by the thermal agent is determined based on the degree of intramuscular temperature increase, duration of temperature increase, size of the area being treated, and rate of temperature rise.² Mild heating of the tissue is a 1°C increase, which increases the metabolic rate of the heated tissues.¹ Moderate heating is a 2°C to 3°C increase that causes a more significant metabolic effect, reduced muscle spasm and pain, and increased circulation to dissipate the heat.¹ Vigorous heating is a 4°C increase that causes an increase in metabolic rate, improved blood flow, reduced muscle spasm and pain, and altered viscoelastic properties of collagen.¹⁻³ These benefits allow a clinician to stretch patients more efficiently because the collagen is more extensible after a 4°C increase.^{1,3}

Clinicians can administer SWD in pulsed or continuous modes. SWD produces an oscillating electromagnetic field that is considered to induce movement of ions, molecule distortion, and eddy current creation within the field. The oscillations result in the thermal effects discussed previously. SWD has the added benefit of being able to heat large areas, such as the gastrocnemius. This ability makes it a more efficacious treatment than ultrasound for treating large areas. According to the evidence, the treatment area for therapeutic ultrasound should be no more than 2 to 3 times the effective radiating area. When the effective radiating area is too large, the transducer head will not evenly heat the tissue to the appropriate temperature. By contrast, induction drum SWD is designed to treat large areas more effectively than ultrasound.^{3,4}

ReBound (ReGear Life Sciences Inc, Pittsburgh, PA) is a thermal agent that was invented in 2008 and presents a new way to increase intramuscular tissue.³ It consists of a helical coil sleeve that wraps around the body part and produces continuous SWD at 35 W and 13.56 MHz.^{2,3} As ReBound is a newer thermal agent, its effectiveness at heating various depths and cooling rates has not been determined. The effectiveness of the modality needs to be assessed for clinicians to decide if ReBound will be a useful application to provide optimal outcomes for patients. Therefore, the purpose of this review is to determine the efficacy of ReBound as a thermal agent at deep and superficial depths.

Focused Clinical Question

In adults (P), is ReBound diathermy (I) compared with other thermal agents (C) as effective at increasing intramuscular tissue temperature by 4°C (O)?

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Summary of Search, “Best Evidence” Appraised, and Key Findings

A synopsis of the level of evidence and key findings from relevant articles on ReBound diathermy was generated.

- The literature search was limited to studies of level 2 evidence or higher.
- Three randomized crossover studies met the criteria for inclusion.^{2–4}
- Two studies^{3,4} compared ReBound with PSWD and one² compared ReBound with MHPs.
- All studies agreed. ReBound does not achieve vigorous (4°C) heating effects during a 30-minute treatment to the triceps surae muscle (depth = 1 and 3 cm). Studies agree that the heat generated by ReBound dissipates slower than ($P < .001$) or at a similar rate as PSWD and faster than MHP ($P < .001$).^{2–4} One study found that intramuscular tissue temperatures increased more with ReBound (3.69°C [1.50°C]) than with MHP (2.82°C [0.90°C]) at superficial depths (1 cm, $d = 0.70$).² Another study found that the MegaPulse II increased intramuscular tissue temperature by 4.32°C (1.79°C) compared with the ReBound’s 2.31°C (0.87°C) temperature increase ($d = 1.43$).³ The final study reported that the MegaPulse II increased triceps surae muscle temperature by 3.47°C (0.92°C) versus ReBound at 3.08°C (1.19°C) ($d = 0.37$).⁴

Clinical Bottom Line

Results strongly indicate that ReBound should not be used for vigorous (4°C) heating effects in the triceps surae muscle at 3 or 1 cm.

Strength of Recommendation

Level B evidence⁵ exists that ReBound can be used to achieve moderate (3°C), but not vigorous (4°C) heating effects at superficial (1 cm) and deep (3 cm) levels.

Search Strategy

Terms Used to Guide Search Strategy

- Population: adults aged 18 to 45
- Intervention: ReBound diathermy
- Comparison: other thermal agents
- Outcome(s): as effective at increasing intramuscular tissue temperature by 4°C

Sources of Evidence Searched

The following information databases were searched for relevant articles to be included in this review:

- Cumulative Index to Nursing and Allied Health Literature (CINAHL)
- PubMed
- The Medical Literature Analysis and Retrieval System Online (MEDLINE)
- Physical Therapy and Sports Medicine Collection
- ScienceDirect

- Cochrane
- ProQuest

Inclusion and Exclusion Criteria

Inclusion

All articles to be included in the appraisal were required to meet the following criteria:

- Peer-reviewed, cross-sectional, or randomized controlled trial
- Compared ReBound with a control group (eg, induction drum SWD, moist heat)
- Adults aged 18 to 45
- Available English abstracts
- Include intramuscular tissue temperature as an outcome
- Written within the last 16 years (January 2000–October 2017)

Exclusion

Articles containing the following criteria were excluded from the review:

- Studies did not compare ReBound with another thermal agent
- Studies were thesis projects

Results of Search

Four studies were identified, and 3^{2–4} met the inclusion criteria, all level 2⁶ randomized crossover studies. A summary chart of the 3 studies can be found in Table 1 (based on Levels of Evidence, Centre for Evidence-Based Medicine, 2011).⁷

Best Evidence

The 3 studies included in this critically appraised topic utilized the “best” evidence (see Table 1). These studies were selected because they were graded as level 2 evidence or higher and compared ReBound with another thermal agent.

Implications for Practice, Education, and Future Research

The purpose of this review is to determine if ReBound is effective when compared with other thermal agents, including MHP and PSWD. All studies in this review^{2–4} demonstrate that ReBound should not be used for vigorous heating effects in the triceps surae muscle. The heat generated by ReBound dissipates quicker than MHP and slower than PSWD.

ReBound has some possible benefits over MHP and PSWD, besides moderate heating at superficial and deep levels. One reason is that ReBound is more portable than MHP and PSWD. Hydrocollators (Chattanooga Corp, Chattanooga, TN) can become heavy when filled with water and MHPs, which limits their portability. The ReBound unit also does not require time to reheat as MHPs do. This lack of reheating time allows clinicians to treat more patients at the appropriate levels, rather than using an MHP that has not reached its highest temperature after treatment. Likewise, induction drum PSWD is not a portable modality as it is generally sold in a tower format that is heavy and bulky. This format renders it

Table 1 Summary of Data Extraction

Author(s)	Study question	Sample	Design	Outcome measures	Results	Level of evidence
Hawkes et al ²	What are the effects of ReBound diathermy compared with silicone-gel MHP on tissue temperature in the triceps surae?	12 college-aged volunteers (average age = 22.2 [2.25] y) with an average subcutaneous fat thickness of 7.2 (1.9) mm.	This crossover study assessed intramuscular tissue temperature for each participant after 30-min treatment on 2 different days with each thermal modality. Temperature decay was recorded for 20 min after treatment.	Intramuscular tissue temperature	Intramuscular temperature had a higher increase with ReBound diathermy at 1 cm than moist heat packs ($F_{6,66} = 7.14$, $P < .001$). From baseline, ReBound diathermy increased temperatures by 3.69°C (1.50°C) and MHP increased by 2.82°C (0.90°C). ReBound diathermy had a greater rate of heat dissipation than moist heat packs ($F_{20,222} = 4.42$, $P < .001$).	2
Draper et al ³	Compare the effects of ReBound diathermy and the MegaPulse II PSWD, an established deep heating diathermy, on tissue temperature of the triceps surae.	12 college-aged volunteers (average age = 22.2 [2.25] y) with an average subcutaneous fat thickness of 7.2 (1.9) mm.	This crossover study assessed intramuscular tissue temperature for each participant after 30-min treatment on 2 different days with each thermal modality. Temperature decay was recorded for 20 min after treatment.	Intramuscular tissue temperature	MegaPulse II had a greater increase in intramuscular tissue temperature than ReBound diathermy at a 3 cm depth ($F_{6,66} = 10.78$, $P < .001$). ReBound diathermy had a slower rate of heat dissipation than MegaPulse II ($F_{20,220} = 28.82$, $P < .001$).	2
Ostrowski et al ⁴	Evaluate ReBound diathermy compared with PSWD for increasing intramuscular temperatures and cooling rates in the triceps surae muscle.	18 healthy participants (average age 22.56 [2.89] y) with an average subcutaneous fat thickness of 5.17 (1.68) mm.	In this crossover study, patients received both treatments for a 30-min heating and 30-min cooling period at a 3 cm depth, with a minimum of 4 d and a maximum of 10 d in between sessions.	Intramuscular tissue temperature	MegaPulse II had a statistically significant increase in intramuscular tissue temperatures compared with ReBound diathermy ($F_{1,17} = 9.04$, $P = .01$); average temperature increase 3.47°C (0.92°C) vs of 3.08°C (1.19°C), respectively. No difference found in decay rates between MegaPulse II and ReBound.	2

Abbreviations: MHP, moist hot packs; PSWD, pulsed shortwave diathermy.

relatively immobile and would, therefore, be unavailable for use when a health care provider is traveling. The PSWD is also very expensive and can be 2 to 4 times the amount of ReBound diathermy.³ The ReBound unit is smaller than a briefcase and could fit in a backpack. The second reason is that the ReBound unit creates heat that lasts longer than PSWD. The 2 studies that compare SWD with ReBound found that the heat generated by ReBound had a slower rate of decay and had a higher temperature after a 30-minute cooling period.^{3,4} If the treatment time is adjusted to allow for the appropriate temperature increase (4°C), then ReBound could allow for a prolonged stretching window after treatment. ReBound diathermy also heats a greater surface area than MHP and SWD as the sleeve wraps around the entire body part. With the right temperature increase (4°C), this larger surface area allows clinicians to stretch the entire muscle group after 1 treatment, rather than doing 2 treatments on each half of the limb. Heating the entire body part also allows clinicians to stretch the agonist and antagonist, which can ensure muscle balance.

However, more research needs to be conducted to determine if ReBound equally heats the entire surface area the sleeve encompasses and the amount of time required to achieve a 4°C increase.

If the clinician is aiming for an increase in blood flow and decreased muscle spasm, pain, and chronic inflammation from a 3°C increase,¹ then a 30-minute ReBound may be appropriate. In these studies, however, ReBound did not achieve vigorous (4°C) levels of heating in a 20- or 30-minute treatment at superficial and deep levels. Because continuous SWD is constantly on, the clinician should be able to use a lower power output to achieve the same effects, but the power output for ReBound may be too low to achieve vigorous heating effects. The power output for ReBound is set at 35 W, whereas the PSWD in these studies was set at 48 W. The difference in power can explain why ReBound would not achieve the same tissue temperature increases as PSWD in a 20- or 30-minute treatment. Modalities should cause a 4°C to 5°C increase in tissue temperature to improve the viscoelastic property of the tissue.^{1,3} To achieve this level of heating, clinicians may have to use a longer

treatment time, which may be impractical in the clinical and athletic settings. Clinic visits are often limited to 45 minutes to an hour, and in many cases, the ReBound treatment cannot be the entire visit. Besides, if an athlete is getting ready for a game or practice, they may not have time for extended treatment in between meetings.

Clinicians should be educated on the appropriate treatment time for desired tissue temperature increase after further research. Without education, they may perform a 20-minute ReBound treatment, expecting to achieve temperatures appropriate for stretching, only to not get the full benefits of vigorous heating levels.

Although this critically appraised topic demonstrates that the ReBound diathermy unit can be used for moderate heating effects, further research should be conducted to solidify this recommendation. Future research should include larger sample sizes, populations with specific pathology, heterogeneous populations, and different muscle groups. Studies should also report heat dissipation rate posttreatment to improve study quality.

References

1. Draper DO, Castel JC, Castel D. Rate of temperature increase in human muscle during 1 MHz and 3 MHz continuous ultrasound. *J Orthop Sports Phys Ther.* 1995;22(4):142–150. PubMed ID: 8535471 doi:10.2519/jospt.1995.22.4.142
2. Hawkes AR, Draper DO, Johnson AW, Diede MT, Rigby JH. Heating capacity of rebound shortwave diathermy and moist hot packs at superficial depths. *J Athl Train.* 2013;48(4):471–476. PubMed ID: 23855362 doi:10.4085/1062-6050-48.3.04
3. Draper DO, Hawkes AR, Johnson AW, Diede MT, Rigby JH. Muscle heating with MegaPulse II shortwave diathermy and ReBound diathermy. *J Athl Train.* 2013;48(4):477–482. PubMed ID: 23725462 doi:10.4085/1062-6050-48.3.01
4. Ostrowski J, Ely C, Evans H, Bocklund D. Comparison of pulsed shortwave diathermy and continuous shortwave diathermy devices. *Athl Train Sports Health Care.* 2016;8(1):18–26. doi:10.3928/19425864-20151119-04
5. Ebell MH, Siwek J, Weiss BD, et al. Strength of Recommendation Taxonomy (SORT): a patient-centered approach to grading evidence in the medical literature. *Am Fam Physician.* 2004;69(3):548–556. PubMed ID: 14971837
6. OCEBM Levels of Evidence Working Group. The Oxford Levels of Evidence 2. *Oxford Centre for Evidence-Based Medicine.* <http://www.cebm.net/index.aspx?o=5653>. Accessed October 27, 2017.
7. Levels of Evidence, Centre for Evidence Based Medicine. 2011. <https://www.cebm.net/2016/05/ocebml-levels-of-evidence/>