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A Systematic Dry-Needling Treatment to Support Recovery Posttraining for Division I Ice Hockey Athletes: An Exploration Case Series

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Context: For this case series, 4 student-athletes (age range = 20–22 years) participating in National Collegiate Athletic Association Division I ice hockey served as cases. They were free of injury and participated in all team activities without restrictions.

Treatment: A dry needling (DN) lower extremity recovery protocol was completed for all athletes during a single session. To administer the DN recovery treatment, we placed static needles in specific bilateral locations that consisted of 5 points on both the anterior and posterior aspects of the lower extremity and lumbopelvic complex. The Acute Recovery Stress Scale was used to evaluate the effect of the DN recovery treatment on each athlete's perception of recovery at 24 and 48 hours post-DN treatment.

Results: Overall, total and average scores of Acute Recovery Stress Scale for all cases were closer to baseline at 48 hours post-DN than at the other time points.

Conclusions: Recovery techniques historically have been used postactivity because even normal training loads, which are considered positive, produce stress and fatigue in athletes and can lead to injury. Results from this case series suggest that ice hockey athletes who are experiencing postexercise stress, such as soreness and fatigue, may benefit from a lower extremity DN recovery treatment protocol.

Key Words: postexercise recovery, wellness screening, performance

Key Points

- A systematic dry-needling protocol to promote recovery for the lower extremity including specific points, needle lengths, needle orientations, and timing was introduced.
- Postactivity dry needling with a lower extremity recovery protocol may produce improvement in patient-perceived recovery and warrants consideration as an intervention to support athlete health.

Recovery after competitive sports is an important consideration to ensure that both athlete performance and well-being are maintained. When an individual's body does not have time to recover postexercise, muscle damage, tightness, soreness, inflammation, fatigue, and loss of cellular homeostasis can occur.[1,2] When these disturbances in homeostasis occur, decreases in both physical and psychological performance can increase the risk of injury.[3,4] Although exercise and activity at any level or dose can stress the body, overtraining is a particular concern in collegiate athletes. Overtraining syndrome has been reported to affect from 15% to 65% of athletes and is individual, sport, and training-load specific.[5] Researchers have suggested that postexercise, 59% of male and female National Collegiate Athletic Association Division I athletes use personal assessments of how they feel during workouts, practice, or competitions to determine if they will use a recovery intervention.[6] In male and female team sports, 57% of athletes at a variety of performance levels incorporate some sort of recovery strategy after training or competition.[7]

Both active and passive recovery interventions are used to reduce stress in athletes by decreasing pain and inflammation while providing them with a sense of decreased fatigue and soreness.[6–8] The use of recovery interventions to assist in balancing the autonomic nervous system to maintain homeostasis is essential because even normal training loads that are considered positive produce stress and fatigue to an athlete and can cause injury.[2] Traditional modality techniques such as massage, water immersion, and compression have been helpful in the postexercise recovery of athletes.[2] Recently, other techniques, such as pneumatic compression and cryogenic therapy, have increased in popularity, and dry needling (DN) continues to be popular because of the positive effects it has on managing a variety of health conditions.[8,9]

Dry needling is thought to positively affect several body-system levels, including local, autonomic, and systemic.[10–12] The insertion of a needle into the body stimulates both neurologic and hormonal processes including pathways for pain control, autonomic nervous system regulation, and cholinergic anti-inflammatory processes,[10–13] all of which may positively support postexercise recovery. Researchers studying DN have suggested that the modality may positively affect pain perception postexercise and reduce fatigue.[9] Dry needling has also been reported to increase regional blood flow and oxygen saturation and to decrease muscle tension, improving range of motion and muscle function.[11,14] However, much is unknown about the influence of DN on postactivity recovery, and no researchers have investigated the effect of a systematic DN recovery protocol on the health of elite National Collegiate Athletic Association Division I collegiate athletes.

Of particular interest is collegiate hockey because of the intensity of the sport on athletes' bodies as well as the rigors of the playing season. Typically, a collegiate hockey season spans 8 months and consists of a rigorous schedule of games on back-to-back nights, frequent practices, individual workouts, weight-training sessions, academic demands, travel, and personal stress. Schedule intensity makes the collegiate ice hockey athletes' lifestyle, nutrition, and recovery techniques critical because they may not have enough time between training sessions to decrease stress and, thus, stress may accumulate. Identifying a recovery protocol that can decrease stress and promote the health and wellness of these athletes is important. Because of the reported benefits of DN treatments, it seems possible that this therapeutic technique may help promote the recovery of collegiate hockey players postactivity. Therefore, the purpose of this case series was to explore the use of a systematic DN lower extremity protocol in healthy collegiate ice hockey athletes to promote recovery postexercise.

CASE PRESENTATION

For this case series, 4 National Collegiate Athletic Association Division I male ice hockey athletes (age range = 20–22 years) who sought treatment for postactivity recovery after ice hockey-related training were included. They were free of injury and were participating in all team ice hockey activities without restrictions. Traditional evaluation of the athletes included an assessment of their overall health, discussion of primary concerns, and monitoring via the Acute Recovery Stress Scale (ARSS) as a part of routine care.

In general, in our health care system, athletes who seek care for postactivity recovery treatment after ice hockey events (eg, training, strength workouts, practices, and competition) are instructed to complete the ARSS at specific time points before and after recovery treatment. Specifically, and related to this case series, athletes who received systematic DN for recovery after ice hockey activity completed the ARSS before receiving the systematic DN recovery intervention (pre-DN) and completed the assessment again at a similar time of day 24 hours after intervention (24-post) and 48 hours after intervention (48-post). All patients in this case series completed the ARSS after ice hockey activity was completed for the day. At a minimum, all athletes practiced (ie, no day off) before ARSS completion for all time points. The ARSS was administered electronically via an electronic medical record. Table 1 presents an overview of the athletes, with attention to their positions, years in school, and primary concerns.

Table 1. Description of Athlete Cases Preintervention

Case No.	Year and Position	Primary Concerns
1	Senior defenseman	Bilateral quadriceps and iliotibial band tightness Gluteal soreness Lower extremity fatigue
2	Junior forward	Bilateral quadriceps tightness Lower extremity fatigue Feels like "legs are burning"
3	Sophomore defenseman	Overall general fatigue Sleeping and eating normally Minor tightness and soreness of lower extremity
4	Sophomore goaltender	Overall fatigue Lower extremity soreness, tightness, and fatigue

Intervention

The ARSS Measurement Tool. The ARSS is a standard component of care. The ARSS consists of 32 Likert-style questions relating to the themes of recovery or stress.[15] Questions related to recovery make up a recovery subscale, and questions related to stress make up a stress subscale. Questions on the ARSS include words and short phrases related to components of recovery or stress, and each specific question is assigned to 1 of the 8 subcategories (ie, 4 subcategories for recovery and 4 subcategories for stress). Recovery subcategories include physical performance capability (PPC), mental performance capability (MPC), emotional balance (EB), and overall recovery (OR). These recovery subcategories reflect perceived levels of strength and energy, alertness, positive mood, and global mental and physical recovery.[15] Stress subcategories include muscle stress (MS), lack of activation (LOA), negative emotional state (NES), and overall stress (OS). These stress subcategories reflect perceived levels of muscle fatigue, motivation or energy, emotional health, or exhaustion.[15] Kellmann and Kölling[15] provided specific definitions for each of the subcategories of the ARSS. The response option for each question in a subcategory are scored from 0 to 6. For each subcategory, a total summary score is calculated by adding the responses for each question; the total score ranges from 0 to 24. Then the mean, which ranges from 0 to 6, is determined and used for analysis.[15] When interpreting the scores, higher scores are better for recovery subcategories, and lower scores are better for stress subcategories. The English version of the ARSS has been translated from the original German version and has been found to have good validity and reliability.[16]

Before administering the ARSS, we provided education and instruction on its purpose and completion via a video presentation to all athletes. The ARSS baseline assessments were administered to athletes on the ice hockey team during a time of low academic and physical stress before the start of the season. When trends in decreased recovery or increased stress were found or an athlete sought treatment because of muscle tightness, soreness, or fatigue, the ARSS instrument was administered, and scores were tracked over time. All data for the ARSS recovery and stress subscales are reported as average scores.

Table 2. Anterior Systematic Recovery Dry-Needle Points[3,17]

Primary Point	Acupuncture Point	Location Description	Needle Length and Gauge	Direction
Deep peroneal	LR3	2 cm proximal to toe webbing between great toe and second ray	15 mm, 0.30	Perpendicular
Tibial	SP6	Medial aspect of distal lower leg, about 6 to 8 cm superior to medial malleolus	30 mm, 0.30	Inferomedial orientation, with anteroposterior insertion
Saphenous	SP9	Medial aspect of knee directly distal to the medial tibial condyle	30 mm, 0.30	Inferomedial orientation, with anteroposterior insertion
Common peroneal	GB34	Lateral aspect of lower leg inferior and anterior to fibular head	30 mm, 0.30	Perpendicular
Iliotibial	GB31	Center of lateral thigh between hip and knee on iliotibial band	75 mm, 0.30	Perpendicular

Dry-Needling Treatment. All athletes were managed using the same lower extremity systematic DN approach and protocol. This DN protocol was designed to decrease pain, assist in maintaining homeostasis, and stimulate the cholinergic anti-inflammatory processes. Static needles were placed in specific locations (Tables 2 and 3) that consisted of 5 bilateral points on both the anterior (Figure 1) and posterior (Figure 2) aspects of the lower extremity and lumbopelvic complex, originating from 24 primary points described by Dung.[17]

Education of the intervention was provided to all athletes, and all patients completed the University Athletic Medicine's DN consent and request for procedure form before treatment. Each athlete received a single DN treatment to support his recovery, and for all athletes, the same athletic training clinician (B.D.B.) performed the treatment. The length and gauge of the needles used (Tables 2 and 3) were at the discretion of the clinician, and for this case series, all athletes were treated using the same needle type because they all had similar body types. Static needles were placed systematically in a distal-to-proximal order for all athletes. All treatments started with anterior needle placement at specified points with athletes in the supine position (Table 2; Figure 1), and then needle placement at posterior points was completed with athletes in the prone position (Table 3; Figure 2). Needles were inserted for a duration of 15 minutes for both anterior and posterior points in all cases. Total treatment time was between 35 and 40 minutes. All treatments were documented within the electronic medical record as part of standard patient care. A record of positive tenderness to palpation, positive twitch response, and positive histamine reaction for each needle location was made for each treatment on all athletes.

OUTCOME

Case 1

All recovery subcategory scores showed improvement at 48-post compared with pre-DN for case 1 (Figures 3 and 4). The PPC was the only subcategory that decreased from pre-DN to 24-post (0.50), but it increased 48-post (1.00). The OR had no change at 24-post compared with pre-DN and then improved between 24-post and 48-post (1.00). Muscular stress on the stress scale showed the greatest improvement of all subcategories at both 24-post (1.00) and 48-post (2.75). The recovery scale showed that 3 of 4 subscales returned to baseline, and all stress scale subcategories either returned to or were better than baseline measurements at 48-post (Figures 3 and 4).

Case 2

For case 2, all recovery subcategory scores showed better scores at 48-post than baseline (Figure 3). Overall recovery on the recovery scale showed the largest improvement, with scores improving at both 24-post (1.25) and 48-post (0.50). Muscular stress had the largest improvement (1.00) on the stress scale, with improvement only occurring between pre-DN and 24-post. All other stress scale subcategories (LOA, NES, and OS) showed improved scores between pre-DN and 24-post and again between 24-post and 48-post, with only 1 (OS) not returning to the baseline score (Figure 4).

Case 3

For case 3, between pre-DN and 24-post, improvement occurred in 3 of 4 recovery scale subcategories and all 4 stress scale subcategories (Figures 3 and 4). Between 24-

Table 3. Posterior Systematic Recovery Dry-Needle Points[3,17]

Primary Point	Acupuncture Point	Location Description	Needle Length and Gauge	Direction
Sural-I	BL57	Between the 2 heads of gastrocnemius muscle in musculotendinous junction	30 mm, 0.30	Perpendicular
Lateral popliteal	BL39	Inferior to the lateral edge of popliteal, on medial side of biceps femoris muscle[9]	30 mm, 0.30	45° Angle away from midline
Inferior gluteal	GB30	Center of gluteal region between sacrum inferior lateral angle and femoral head	75 mm, 0.30	Perpendicular
Superior cluneal	YaoYan	Highest point of iliac crest	50 mm, 0.30	Tilted >45° downward and inferior to iliac crest
Posterior cutaneous of L5	BL25	Lateral margin (bulge) of erector spinae muscle, about 3 cm from spinous process L5	50 mm, 0.30	Inferomedial orientation

Figure 1. Anterior needle point locations.

Figure 2. Posterior needle point locations.

post and 48-post, all recovery and stress scale subcategories showed improvement (Figures 3 and 4). The PPC of the recovery scale showed the most improvement between pre-DN and 24-post (1.00) and also between pre-DN and 48-post (2.25). The MS and OS subcategories showed the greatest improvement on the stress scale between pre-DN and 48-post (2.25). No scores returned to baseline measures, but the clinician documented that the patient was feeling better.

Case 4

At 48-post, 4 of 8 subcategories for both recovery and stress scales returned to baseline or better for case 4 (Figures 3 and 4). Between pre-DN and 24-post, 5 subcategories (PPC, MPC, OR, MS, and OS) showed improvement, 1 subcategory (NES) had no change, and 2 subcategories (EB and LOA) showed a decrease in scores (Figures 3 and 4). The OR and MPC of the recovery scale both had the greatest score improvements (1.25) of any subcategory. The MS showed improvement on the stress scale (1.00) and returned to baseline as 24-post, but then it decreased between 24-post and 48-post (0.25).

Other Patient Reactions

Using standard documentation processes, we extracted the following information about the DN lower extremity protocol. Specific point locations used in the protocol produced positive tenderness to palpation in 88.8% (71/80) of points for all athletes. Twitch responses elicited via needle insertion occurred in 11.3% (9/80) of locations in athletes. Histamine reactions occurred at 26.3% (21/80) of all points, with 100% (8/8) of those reactions occurring at the superior cluneal location. The only adverse reaction noted was minimal and tolerable pain with needle insertion at various locations.

DISCUSSION

This case series provides evidence to support the use of DN as a recovery tool for athletes postexercise. After DN treatment, improvements were seen in many of the 8 subcategories within the ARSS. Four ARSS subcategories (PPC, OR, MS, and OS) showed the most consistent positive change at 24-post and 48-post during a time at which training loads are high in collegiate ice hockey players. Two subcategories (NES and LOA) of the stress scale showed little consistency among cases at 24-post but more consistent positive improvements at 48-post. Two subcategories (MPC and EB) of the recovery scale showed the least change and consistency among athletes at both 24-post and 48-post. Collette et al[18] found that the same 4 subcategories (PPC, OR, MS, and OS) of the ARSS were are appropriate to use when assessing the recovery stress cycle of swimmers. In this case series, we report on the stress that many athletes experience postexercise, such as soreness and fatigue, and present a lower extremity DN recovery treatment strategy that might help reduce these effects postexercise.

The particular lower extremity DN recovery protocol selected for this case series was derived from the 24 primary points described by Dung.[17] For the recovery protocol, needles were placed at 5 bilateral points on the anterior and posterior aspects of the lower extremity. The focus of these lower extremity points was to assist in pain

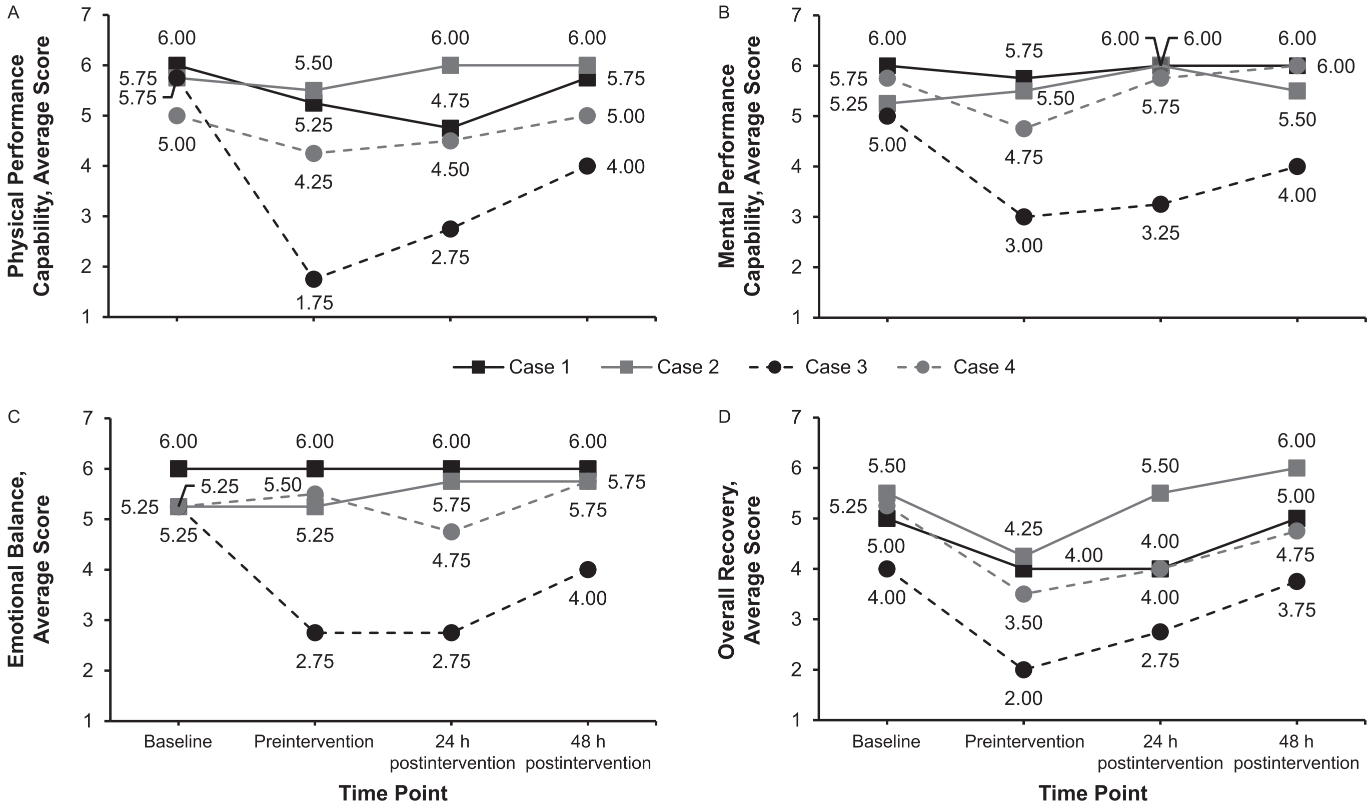

Figure 3. Acute Recovery Stress Scale (ARSS) recovery subcategory scores for all 4 cases. A, Physical performance capability; B, mental performance capability; C, emotional balance; and D, overall recovery average scores stratified by athletes at all time points when ARSS was administered.

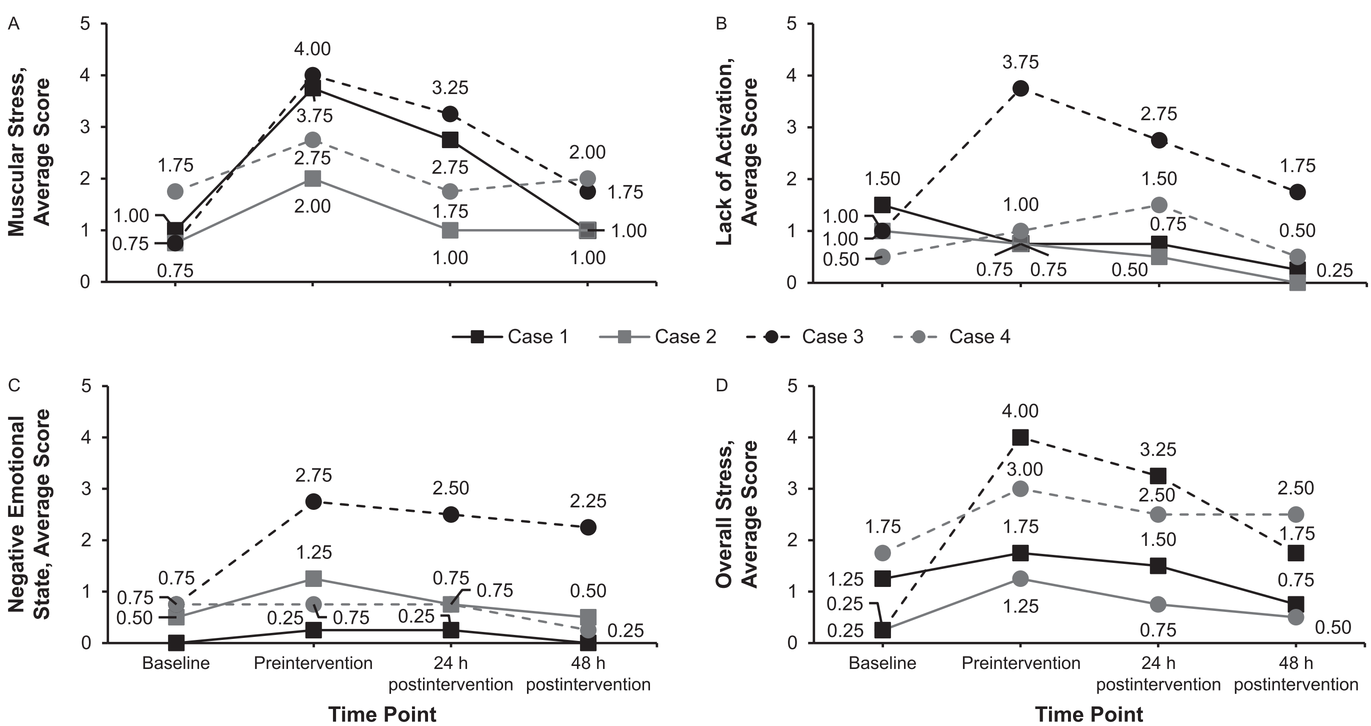

Figure 4. Acute Recovery Stress Scale (ARSS) stress subcategory scores for all 4 cases. A, Muscular stress; B, lack of activation; C, negative emotional state; and D, overall stress average scores stratified by athletes at all time points when ARSS was administered.

control and initiate the cholinergic anti-inflammatory process of the lower extremity while promoting systematic homeostasis via autonomic nervous system regulation. Clinically, all athletes reported perceived improvement in recovery and stress, as measured using the ARSS, after treatment. These findings suggested that DN warrants further exploration as a treatment intervention to support athlete health and recovery postexercise.

Other researchers[4,8,19,20] have found that needling might assist with sports recovery. Lin et al[19] found positive effects in heart rate, oxygen consumption, and blood lactate levels postexercise when using acupuncture points Neiguan (PC6) and Zusanli (ST36).[20] The needles in these studies were inserted pre-exercise and remained in the body during exercise,[19,20] which is different from what was done in the current case series. In another study, Ma et al[4] used Zusanli (ST36), Weizhong (BL40), Guanyuan (CV4), and Shenshu (BL23) acupuncture points in an acupuncture group compared with a rest group and noted that evidence from urinalyses suggested that acupuncture may relieve fatigue in individuals postexercise. Urroz et al[8] used acupuncture points Neiguan (PC6) and Zusanli (ST36) plus Lieque (LU7) and Tanzhang (REN17) to investigate the effects of needling on physiological measures after a single bout of maximal exertion. They used methods that included placebo and control groups and observed no physiological benefit from needling.[8] However, they did find that individuals who were told they received real acupuncture treatment perceived they recovered more quickly.[8] All of these researchers looked at physiological effects that could benefit recovery, with assessments made up to 60 minutes postexercise.[19,20] This case series represents how athletes can feel subjectively, not only from the physical stress of sport but also from mental and emotional stress, and provides compelling data that DN may assist in decreasing stress and improving recovery over much longer recovery times (eg, 24 and 48 hours postexercise). Prospective studies including larger patient populations and extended recovery times are needed to better understand the physiological and subjective effects of DN on recovery.

To our knowledge, no literature exists on the specific lower extremity DN protocol used for this case series, which makes its use in this case series important. Needling points for this DN protocol consisted of locations only on the lower extremity and lumbopelvic regions.[17] Melzack et al[21] first proposed that acupoints and myofascial trigger points have a high degree of correlation. Dung[17] questioned whether myofascial trigger points exist, as they are not seen in gross anatomy books, and stated, "trigger points and acupoints have identical anatomical features and localities." During this case series, data were collected on points that were tender to palpation. We found that 88.8% of the lower extremity primary points used for this DN protocol were tender with palpation, which is very similar to findings reported by Dung[17] (88.87% were tender with palpation). A local twitch response has been associated with immediate improvement in muscle function,[22] and a twitch response was elicited in 11.3% of points where a needle was placed across athletes. The local twitch response may have been low in our athletes, but twitch response had no immediate effect on pain or muscle function 1 week after needle intervention.[11,22] We observed a histamine response at 26.3% of points, with 100% of those athletes having a histamine response at the superior cluneal insertion point. Blocking histamine during exercise results in muscle strength loss and increased creatine kinase; therefore, in theory, the presence of histamine could positively affect recovery postexercise.[23,24]

An important feature of this case series was the routine and consistent assessment of recovery via case evaluation using the ARSS. Use of the ARSS provided insight into the patient perspective of health status, which is essential for comprehensive patient monitoring and driving treatment decisions. Subjective assessment based on patient input addresses a limitation of traditional clinical evaluation practices that emphasize clinician assessments, performance evaluations, and informal daily patient-clinician interactions. Although data from the ARSS may be subjective, evidence of objectivity of the score exists because the tool has been found to be reliable and valid. Further subjective measures were more responsive and consistent than objective measurements.[25] Because of these factors, it appears that the DN protocol helped improve the recovery stress state of the 4 athletes, and this finding should be confirmed by researchers including a larger population of athletes and control groups.

This case series provided evidence that supports a systematic lower extremity DN protocol for the recovery of athletes postactivity. Data from the ARSS showed improvement of subjective measures for both recovery and stress at 24-post and 48-post in collegiate ice hockey student-athletes. Limitations of this case series included no physiological biomarkers, no objective performance indicators, no restriction on self-care, and no consistent exercise load parameters. Even with these limitations, the findings from this case series support the need for more research that includes clinical trials on the possible benefits of DN postactivity for athletes. Researchers should also look at specific anatomical DN points that produce the greatest benefit for a minimal dose effect, with extended time points to identify specific protocols.

CLINICAL BOTTOM LINE

The systematic DN recovery protocol in this case series involved using static needle placement for 15 minutes at 5 bilateral points on the anterior (10 needles) and posterior (10 needles) aspect of the lower extremity. This systematic DN protocol warrants attention as an intervention because it produced positive effects on athlete health. Clinician-observed effects included twitch responses and histamine reactions. The only adverse reaction was pain reported by athletes with needle insertion. Researchers using this specific DN protocol need to further evaluate the effectiveness of this treatment for reducing the stress and fatigue experienced by athletes postexercise.

REFERENCES

1. Kellmann M, Bertollo M, Bosquet L, et al. Recovery and performance in sport: consensus statement. *Int J Sports Physiol Perform*. 2018;13(2):240–245. doi:10.1123/ijspp.2017-0759
2. Dupuy O, Douzi W, Theurot D, Bosquet L, Dugue B. An evidence-based approach for choosing post-exercise recovery techniques to reduce markers of muscle damage, soreness, fatigue, and inflam-

mation: a systematic review with meta-analysis. *Front Physiol*. 2018;9:403. doi:10.3389/fphys.2018.00403
3. Ma Y. *Biomedical Acupuncture for Sports and Trauma Rehabilitation: Dry Needling Techniques*. Churchill Livingstone; 2011.
4. Ma H, Liu X, Wu Y, Zhang N. The intervention effects of acupuncture on fatigue induced by exhaustive physical exercises: a metabolomics investigation. *Evid Based Complement Alternat Med*. 2015;2015:508302. doi:10.1155/2015/508302
5. Cadegiani FA, Kater CE. Novel insights of overtraining syndrome discovered from the EROS study. *BMJ Open Sport Exerc Med*. 2019;5(1):e000542. doi:10.1136/bmjsem-2019-000542
6. Murray A, Fullagar H, Turner AP, Sproule J. Recovery practices in Division I collegiate athletes in North America. *Phys Ther Sport*. 2018;32:67–73. doi:10.1016/j.ptsp.2018.05.004
7. Crowther F, Sealey R, Crowe M, Edwards A, Halson S. Team sport athletes' perceptions and use of recovery strategies: a mixed-methods survey study. *BMC Sports Sci Med Rehabil*. 2017;9:6. doi:10.1186/s13102-017-0071-3
8. Urroz P, Colagiuri B, Smith CA, Yeung A, Cheema BS. Effect of acupuncture and instruction on physiological recovery from maximal exercise: a balanced-placebo controlled trial. *BMC Complement Altern Med*. 2016;16:227. doi:10.1186/s12906-016-1213-y
9. Garlanger KL, Fredericks WH, Do A, Bauer BA, Laskowski ER. The feasibility and effects of acupuncture in an adolescent Nordic ski population. *PM R*. 2017;9(8):795–803. doi:10.1016/j.pmrj.2016.11.010
10. Cheng KJ. Neurobiological mechanisms of acupuncture for some common illnesses: a clinician's perspective. *J Acupunct Meridian Stud*. 2014;7(3):105–114. doi:10.1016/j.jams.2013.07.008
11. Cagnie B, Dewitte V, Barbe T, Timmermans F, Delrue N, Meeus M. Physiologic effects of dry needling. *Curr Pain Headache Rep*. 2013;17(8):348. doi:10.1007/s11916-013-0348-5
12. Uchida C, Waki H, Minakawa Y, et al. Effects of acupuncture sensations on transient heart rate reduction and autonomic nervous system function during acupuncture stimulation. *Med Acupunct*. 2019;31(3):176–184. doi:10.1089/acu.2019.1350
13. Jin BX, Jin LL, Jin G-Y. The anti-inflammatory effect of acupuncture and its significance in analgesia. *World J Acupunct Moxibustion*. 2019;29(1):1–6. doi:10.1016/j.wjam.2019.03.003
14. Mansfield CJ, VanEtten L, Willy R, di Stasi S, Magnussen R, Briggs M. The effects of needling therapies on muscle force production: a systematic review and meta-analysis. *J Orthop Sports Phys Ther*. 2019:49(3):154–170. doi:10.2519/jospt.2019.8270
15. Kellmann M, Kölling S. *Recovery and Stress in Sport: A Manual for Testing and Assessment*. Taylor & Francis; 2019.
16. Kölling S, Schaffran P, Bibbey A, et al. Validation of the Acute Recovery and Stress Scale (ARSS) and the Short Recovery and Stress Scale (SRSS) in three English-speaking regions. *J Sports Sci*. 2020;38(2):130–139. doi:10.1080/02640414.2019.1684790
17. Dung H. *Acupuncture: An Anatomical Approach*. 2nd ed. Routledge; 2013.
18. Collette R, Kellmann M, Ferrauti A, Meyer T, Pfeiffer M. Relation between training load and recovery-stress state in high-performance swimming. *Front Physiol*. 2018;9:845. doi:10.3389/fphys.2018.00845
19. Lin ZP, Lan LW, He TY, et al. Effects of acupuncture stimulation on recovery ability of male elite basketball athletes. *Am J Chin Med*. 2009;37(3):471–481. doi:10.1142/S0192415X09006989
20. Urroz P, Colagiuri B, Smith CA, Cheema BS. Effect of acute acupuncture treatment on exercise performance and postexercise recovery: a systematic review. *J Altern Complement Med*. 2013;19(1):9–16. doi:10.1089/acm.2011.0727
21. Melzack R, Stillwell DM, Fox EJ. Trigger points and acupuncture points for pain: correlations and implications. *Pain*. 1977;3(1):3–23. doi:10.1016/0304-3959(77)90032-X
22. Koppenhaver SL, Walker MJ, Rettig C, et al. The association between dry needling-induced twitch response and change in pain and muscle function in patients with low back pain: a quasi-experimental study. *Physiotherapy*. 2017;103(2):131–137. doi:10.1016/j.physio.2016.05.002
23. Ely MR, Romero SA, Sieck DC, Mangum JE, Luttrell MJ, Halliwill JR. A single dose of histamine-receptor antagonists before downhill running alters markers of muscle damage and delayed-onset muscle soreness. *J Appl Physiol (1985)*. 2017;122(3):631–641. doi:10.1152/japplphysiol.00518.2016
24. Luttrell MJ, Halliwill JR. The intriguing role of histamine in exercise responses. *Exerc Sport Sci Rev*. 2017;45(1):16–23. doi:10.1249/JES.0000000000000093
25. Saw AE, Main LC, Gastin PB. Monitoring the athlete training response: subjective self-reported measures trump commonly used objective measures: a systematic review. *Br J Sports Med*. 2016;50(5):281–291. doi:10.1136/bjsports-2015-094758

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