Original Article

Effectiveness of Combined Dry Needling and Progressive Loading for Greater Trochanteric Pain Syndrome: A Randomized Controlled Trial

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ABSTRACT

Background: Greater Trochanteric Pain Syndrome (GTPS) is a prevalent condition affecting about 10-25% of the general population, presenting as chronic lateral hip pain, which can impair function and quality of life. There are many potential interventions for GTPS, but there is little evidence for the effectiveness of dry needling with progressive loading exercise. This study aimed to determine the effect of dry needling with progressive loading exercise compared to standard care for patients with GTPS.

Methods: In this assessor-blinded randomized controlled trial, conducted in Islamabad, Pakistan, 124 adults (30-65y) were recruited with a diagnosis of GTPS and were randomized to either receive dry needling with progressive loading exercise (intervention group, n=62) or standard care (control group, n=62), with 12 sessions over 6 weeks. The primary outcome was pain intensity measured with the Numerical Pain Rating Scale (NPRS), while the secondary outcomes were Hip Disability and Osteoarthritis Outcome Score (HOOS), pressure pain threshold (PPT), and Global Rating of Change (GROC). Assessments were conducted at baseline, 6 weeks, and 12 weeks.

Results: At 12-week follow-up, the intervention group showed a significantly greater reduction in pain intensity compared to the control group (between-group mean difference: -2.3 points, 95%CI [-2.8,-1.8], p<0.001). Greater improvements were also observed for all other HOOS subscales, augmented for Sport/Recreation Function (19.9 points) and Quality of Life (20.4 points). The intervention group self-reported larger success rates (GROC ≥+4) than the control group at 12-week follow-up (81.4% versus 43.1%, p<0.001).

Conclusion: Combined dry needling and progressive loading exercises are superior to the standard of care for reducing pain and improving function in individuals with GTPS, sustained at a 12-week follow-up.

Keywords: Dry needling; Exercise therapy; Greater trochanteric pain syndrome; Hip pain; Rehabilitation.

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INTRODUCTION

Greater trochanteric pain syndrome (GTPS) is a common musculoskeletal disorder that is defined by chronic, intermittent pain and tenderness over the lateral hip[1]. The condition affects 10 to 25% of the general population and the incidence rate increases in middle-aged women and individuals who are running or very active[2].

GTPS encompasses a range of disorders, including gluteal tendinopathy, trochanteric bursitis, and gluteus medius tears, as well as minimizing tendons[3]. It is generally accepted as mechanical compression, tendon wear and tear, and altered muscle and soft tissue pathology loading. Although it was once believed to be an isolated inflammation affecting the hip bursa, recent studies have identified that it generally relates to an issue with the tendon of the gluteal muscles at the attachment of the tendon to the greater trochanter bone[4,5].

Current management strategies for GTPS include education, activity modification, corticosteroid injections, therapeutic exercises, manual therapy,

and shockwave therapy[6]. While there are numerous approaches to treating the condition, there is limited, high-quality evidence to support any one single intervention, and the recurrence rates remain high[7]. Similarly, corticosteroid injections, while providing short-term pain relief, have high rates of symptom recurrence and may have negative consequences for tendon integrity with repeated administrations[8].

Dry needling has emerged as a potential treatment method for musculoskeletal conditions, including tendinopathies and myofascial pain syndromes[9]. Dry needling utilizes filiform needles inserted into myofascial trigger points or areas of tissue dysfunction without injection of a substance[10]. Dry needling is proposed to produce effects through multiple physiological mechanisms, including local mechanical disruption of dysfunctional tissue, alterations in local blood flow, and neurophysiological effects that impact pain perception[11]. Progressive loading exercises have been demonstrated to effectively manage tendon conditions based on influencing tendon remodelling and increasing load tolerance[12]. For GTPS, progressive loading typically involves graduated strengthening of the gluteal muscles from isometric contractions through eccentric, concentric, and functional exercises as symptoms allow[4]. Although both dry needling and progressive loading exercises have independently shown benefits for several musculoskeletal conditions, research into their combined effectiveness specifically for GTPS is limited. If there is a synergistic benefit to these interventions, it could address both the peripheral nociceptive components of GTPS and the functional deficits, yielding a greater benefit than standard care.

The burden of musculoskeletal pain is significant in the Pakistani population, and it is increasing, particularly in urban environments, with GTPS among those presentations[13]. The burden of globalization, sedentary lifestyle and compliance to jobs in urban environments has contributed significantly to the burden of musculoskeletal disorders. While the burden of GTPS is increasing, there is little research on the effectiveness of contemporary physical therapy for GTPS in the Pakistani population.

This randomized controlled trial assessed the effectiveness of combined dry needling and progressive loading exercises compared to standard care for patients with GTPS in Islamabad, Pakistan. We hypothesized that the interventions would result in greater pain reduction and functional improvement outcomes than standard care alone.

METHODOLOGY

Study Design

This study is a parallel-group, assessor-blinded, randomized controlled trial conducted in Islamabad, Pakistan, from October 2023 to April 2024.

Recruitment

Participants were recruited from the outpatient physiotherapy departments of three leading hospitals in Islamabad: Pakistan Institute of Medical Sciences (PIMS), Federal Government Services Hospital (Polyclinic), and Shifa International Hospital through physician referrals and community advertisements.

Inclusion Criteria

- Participants must be adults aged 30-65 years,
- Participants must have a clinical diagnosis of GTPS based on:
  - Lateral hip pain (>3 month duration),
  - Pain on palpation over the greater trochanter,
  - Positive on at least two of three clinical tests: FABER test, resisted external derotation test, single-leg stance test,
- Pain intensity of > 3/10 on the Numerical Pain Rating Scale (NPRS),
- Ability to comprehend and follow verbal instructions in either English or Urdu.

Exclusion Criteria

- Previous surgery of the hip or hip arthroplasty,
- Lumbar radiculopathy or any other neurological condition affecting the lower limb,
- Inflammatory arthritis, an autoimmune or systemic disorder affecting musculoskeletal tissue,
- Corticosteroid injection into the affected hip within the last 3 months,
- Previous dry needling treatment for GTPS in the last 6 months,
- Coagulation disorders or taking anticoagulant medication,
- Pregnancy,

- Severe psychiatric illness that impacts participation.

Randomization and Blinding

Eligible participants were randomized to either the intervention group (dry needling plus progressive loading exercise) or the control group (standard care) using an independent statistician-generated random number sequence with a 1:1 allocation ratio. The allocation sequence was concealed using sequentially numbered opaque sealed envelopes to prevent selection bias.

Due to the interventions' nature, therapists and participants could not be blinded to group allocation. However, assessors were blinded to group allocation, and participants were instructed not to reveal their treatment to assessors. Assessors' blinding success was assessed post-study.

Interventions

Both groups received 12 treatment sessions over 6 weeks (two sessions per week for the first four weeks and one session per week for the last two weeks). Physical therapists provided all interventions with at least five years of clinical experience and who were trained in study protocols.

Intervention Group
(Dry Needling and Progressive Loading)

Dry Needling: Thin, sterile needles (0.30 × 50 mm) were applied to tender locations in the hip musculature on four primary muscles:

- The Gluteus Medius (All Three Parts)
- Gluteus Minimus
- Tensor Fasciae Latae
- Any Painful Trigger Points around The Hip

Depending on each person's body type and the treated muscle, the needles were inserted to depths (25-60 mm). Each needle was gently manipulated to induce a slight muscle twitch, likely promoting relaxation. The needles remained in place for 10 minutes, with a slight twist at the halfway point. Patients received treatment for the first eight visits (2x/ week for 4 weeks).

Progressive Loading Protocol: The exercise program followed a progressive loading protocol increasing in complexity:

- **Weeks 1-2:** Basic holds in lying or sitting (hold for 45 seconds, three sets of 5 repetitions, working up to 10 repetitions)
- **Weeks 3-4:** Movement exercises with limited weight bearing on the affected leg (3 sets of 10 repetitions, adding load gradually)
- **Weeks 5-6:** Functional exercises like step-ups, lunges, and single-leg balance (3 sets of 12 repetitions, making them gradually more challenging)

The participants were encouraged to do the exercises at home every day, within reason, progressing the exercises based on the response of their hip.

Control Group
(Standard Care)

- Education on GTPS pathology, aggravating factors, and activity modification
- Advice on the best sleeping and sitting position for optimally avoiding compression of the greater trochanter
- 10-minute application procedure of superficial heat
- Static stretching of the iliotibial band and piriformis (3 repetitions of a 30-second hold)
- Non-progressive, submaximal isometric gluteal contractions (3 sets of 10 repetitions)
- General hip mobility exercises (3 sets of 10 repetitions)
- Participants were encouraged to do the exercises at home every day.

Both groups were provided with home exercise manuals (i.e. written and illustrated) in the language of their choice (English or Urdu).

Outcome Measures

Assessment points were at baseline (week 0), mid-intervention (week 6), and post-intervention (week 12).

Primary Outcome Measure

- **Pain Intensity:** Pain intensity was assessed with the Numerical Pain Rating Scale (NPRS), where 0 is “no pain” and 10 is “worst pain imaginable.” Participants rated their average pain intensity from the previous week. The NPRS has excellent test-retest reliability (ICC = 0.95) and a minimal clinically important difference (MCID) of 2-point increase for chronic musculoskeletal pain patients[9].

Secondary Outcome Measures

- **Functional Disability:** Functional disability was assessed using the Hip Disability and Osteoarthritis Outcome Score (HOOS). This self-administered questionnaire has 40 items divided into five subscales: Pain, Symptoms, Activities of Daily Living, Sport and Recreation Function, and Quality of Life. Each subscale receives a score of 0-100, where a higher number indicates better hip-related function. The HOOS has acceptable reliability and validity for hip disorders[9].

- **Pressure Pain Threshold (PPT):** Assessed using a digital algometer (Wagner Instruments, Greenwich, CT), which was applied vertically to the most painful point over the greater trochanter. The pressure was applied and increased at a constant rate of 1 kg/second until the participant indicated the pressure became painful. Three measures were taken with a 30-second interval, and an average value was calculated. Higher values reflect lower sensitivity to pressure[10].

- **Global Rating of Change (GROC):** Assessed at weeks 6 and 12 using a 15-point scale that ranged from -7 ("a very great deal worse") to +7 ("a very great deal better") and 0 indicating "no change." A score of +4 or higher was determined to be a successful outcome[11-12].

- **Adherence to Home Exercise Program:** Participants kept an exercise diary documenting the frequency of home exercise completion, which was collected at regular follow-up appointments.

Sample Size Calculation

The sample size was determined based on a clinically meaningful difference of 2 points on the NPRS between groups and a pre-specified standard deviation of 2.5 points. For a two-tailed alpha of 0.05 and 90% power, a total sample of at least 51 participants per group was required. Because we anticipated a 20% dropout rate, we aimed to recruit 124 participants (62 per group).

Statistical Analysis

Statistical analyses were completed using SPSS software (version 26.0; IBM Corp., Armonk, NY). The Shapiro-Wilk test was used for normality testing. Baseline demographic and clinical characteristics were compared between groups using independent t-tests for continuous variables and chi-square tests for categorical variables.

For the primary and secondary continuous outcomes, mixed-model analysis of variance (ANOVA) was used with time (baseline, 6 weeks and 12 weeks) as the within-subjects factor and group (intervention and control) as the between-subjects factor. Post hoc analyses for significant interactions were carried out using Bonferroni adjustments. The GROC data were analyzed using the Mann-Whitney U test to identify whether there were any differences between groups.

An intention-to-treat analysis was completed, and missing data were addressed using multiple imputation methods. A level of significance of $p<0.05$ was accepted for all analyses.

RESULTS

Participant Flow and Characteristics

Of the 187 screened for eligibility, 124 were randomized to an intervention group (n = 62) or control group (n = 62) after meeting the inclusion criteria. Seven of the 124 participants participating in the study were lost to follow-up (3 interventions and four control), resulting in an overall retention rate of 94.4%. Of the 7 participants lost to follow-up, 6 participants reported that they stopped participating due to relocation (3 participants), demands on their time (2 participants), and unrelated medical issues (2 participants), as shown in Figure-1.

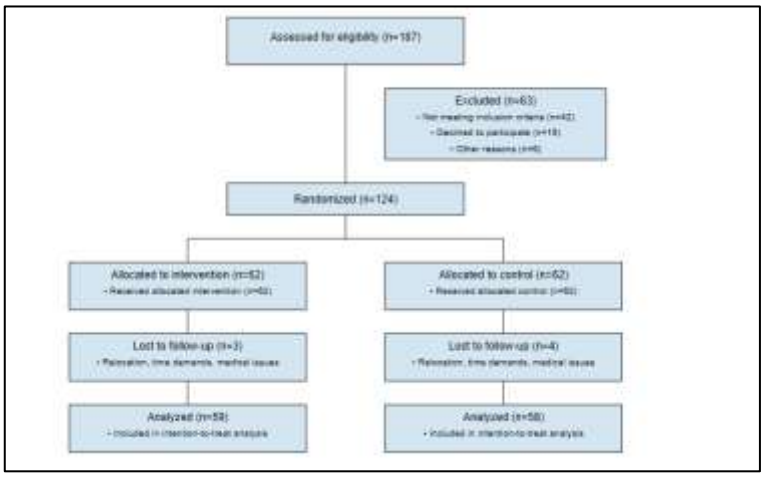

Figure-1 CONSORT Flow Diagram

Baseline demographic and clinical characteristics were comparable between the two groups (Table-1). The average age of participants was 48.7±9.3 years, and 71% were female. The mean duration of symptoms was 9.2±5.7 months, and 35% of participants reported bilateral GTPS.

NPRS

Both groups exhibited a reduction in pain intensity from the baseline at the 12-week follow-up, with the intervention group showing statistically significantly greater reductions in pain intensity (Table-2).

At the 6-week follow-up, the NPRS mean scores decreased from 6.5±1.4 to 3.8±1.6 in the intervention group and from 6.4±1.5 to 5.1±1.7 in the control group (between-group mean difference: -1.3 points, 95%CI [-1.8, -0.8], p<0.001).

At the 12-week follow-up, the NPRS mean scores while the control group's scores decreased from 6.5±1.4 to 4.5±1.8 (between-group mean diff -2.3 in the intervention group contrasted greatly with the control group, decreasing from 3.5±1.4 to 2.2±1.5, points, 95%CI [-2.8,-1.8], p<0.001).

Table-1. Baseline Demographic and Clinical Characteristics of Participants

Characteristic	Intervention Group (n=62)	Control Group (n=62)	p-value
Age, years (Mean ± SD)	48.2±9.5	49.1±9.1	0.574
Female, n (%)	45 (72.6)	43 (69.4)	0.687
BMI, kg/m² (Mean ± SD)	27.3±3.8	27.5±4.1	0.715
Duration of symptoms, months (Mean ± SD)	9.5±6.0	8.9±5.4	0.628
Bilateral GTPS, n (%)	23 (37.1)	20 (32.3)	0.573
Previous physical therapy, n (%)	29 (46.8)	31 (50.0)	0.723
Previous corticosteroid injection, n (%)	14 (22.6)	17 (27.4)	0.533
NPRS score (Mean ± SD)	6.5±1.4	6.4 ±1.5	0.641
HOOS scores (Mean ± SD)			
- Pain	58.4±12.6	57.9±13.2	0.712
- Symptoms	60.7±13.8	59.5±14.6	0.526
- Activities of Daily Living	62.5±15.3	61.8±14.9	0.638
- Sport and Recreation	45.3±16.7	46.2±17.1	0.582
- Quality of Life	43.2±15.4	42.5±14.8	0.659
Pressure Pain Threshold, kg/cm² (Mean ± SD)	2.1±0.7	2.0±0.8	0.467

BMI = Body Mass Index; NPRS = Numerical Pain Rating Scale; HOOS = Hip Disability and Osteoarthritis Outcome Score; SD = Standard Deviation

HOOS

Compared to the control group, the intervention group showed significantly greater improvements in all HOOS subscales than the control group regarding both (6-week and 12-week follow-up) follow-up time points (Table-2). The most remarkable between-group differences were in the Sport and Recreation Function and Quality of Life HOOS subscales at week 12, with mean differences of 19.9 points (95% CI [14.2, 25.6], p<0.001) and 20.4 points (95% CI 15.1, 25.7], p<0.001), respectively.

Pressure Pain Threshold

The intervention group showed significantly greater increases in PPT over the greater trochanter group than the control group. By week 12, the mean PPT increased from 2.1±0.7 kg/cm² to 4.3±1.1 kg/cm² in the intervention group and from 2.0±0.8 kg/cm² to 2.9±0.9 kg/cm² in the control group (between-group mean difference = 1.4 kg/cm², 95% CI [1.1, 1.7], p<0.001).

GROC

At Week 6, the median GROC score was +4 (interquartile range [IQR]: +3 to +5) in the intervention group and +2 (IQR: 0 to +3) in the control group (p<0.001). At Week 12, the median GROC score was +5 (IQR: +4 to +6) in the intervention group and +3 (IQR: +1 to +4) in the control group (p<0.001). A successful outcome (GROC ≥ +4) at 12 weeks was achieved by 81.4% (48/59) of participants in the intervention group, compared to 43.1% (25/58) of participants in the control group (p<0.001).

Adherence to the treatment

Self-reported adherence to the home exercise program was similar across groups. In the intervention group, 76.3% (45/59) of participants reported completion of at least 80% of the prescribed home exercise as compared to 72.4% (42/58) in the control group (p=0.631).

Adverse Events

No serious adverse events were reported in either group. Minor adverse events were reported for the intervention group as follows: soreness after needling (n=23, 37.1%), temporary bruising at the site of needling (n=14, 22.6%), and temporary fatigue experienced after exercise (n=10, 16.1%). Minor adverse events for the control group were reported as temporary soreness (n=8, 12.9%). All reported adverse events were minor and resolved within 48 hours without further medical intervention.

Table-2. Changes in Primary and Secondary Outcomes Over Time

Outcome Measure	Group	Baseline	Week 6	Week 12	Between-Group Mean Difference (95% CI)
NPRS (0-10)	Intervention	6.5±1.4	3.8±1.6*	2.2 ± 1.5*	Week 6: -1.3 (-1.8, -0.8)†
	Control	6.4±1.5	5.1± 1.7*	4.5 ± 1.8*	Week 12: -2.3 (-2.8, -1.8)†
HOOS Pain (0-100)	Intervention	58.4±12.6	72.6± 13.5*	81.3 ± 14.2*	Week 6: 9.7 (5.9, 13.5)†
	Control	57.9±13.2	62.9± 14.1*	66.5 ± 15.3*	Week 12: 14.8 (10.3, 19.3)†
HOOS Symptoms (0-100)	Intervention	60.7±13.8	73.5± 14.2*	82.1 ± 14.6*	Week 6: 8.6 (4.5, 12.7)†
	Control	59.5±14.6	64.9± 15.3*	68.5 ± 15.8*	Week 12: 13.6 (9.1, 18.1)†
HOOS ADL (0-100)	Intervention	62.5±15.3	75.3± 15.8*	84.7 ± 14.9*	Week 6: 10.2 (6.1, 14.3)†
	Control	61.8±14.9	65.1± 15.6*	69.5 ± 16.2*	Week 12: 15.2 (10.7, 19.7)†
HOOS Sport (0-100)	Intervention	45.3±16.7	62.4± 17.5*	73.6 ± 18.2*	Week 6: 14.1 (9.2, 19.0)†
	Control	46.2±17.1	48.3± 17.8	53.7 ± 18.5*	Week 12: 19.9 (14.2, 25.6)†
HOOS QOL (0-100)	Intervention	43.2±15.4	59.6± 16.3*	72.3 ± 17.1*	Week 6: 13.9 (9.0, 18.8)†
	Control	42.5±14.8	45.7±15.9	51.9 ± 16.7*	Week 12: 20.4 (15.1, 25.7)†
PPT (kg/cm²)	Intervention	2.1±0.7	3.4±0.9*	4.3 ± 1.1*	Week 6: 0.9 (0.6, 1.2)†
	Control	2.0±0.8	2.5±0.8*	2.9 ± 0.9*	Week 12: 1.4 (1.1, 1.7)†

DISCUSSION

This randomized controlled trial indicated that a combination of dry needling and progressive loading is more effective than the current standard of care for patients with GTPS. The treatment group showed clinically meaningful improvements in pain intensity, functional disability, pressure pain thresholds, and global change rating compared to the control group at 6- and 12-week follow-up.

The treatment group scored a 2.3-point difference (in NPRS) in pain intensity, which is significant, especially at 12 weeks when the minimum clinically important difference previously established was 2 points. We have expanded upon previous and current literature on the studies of GTPS interventions in multiple ways. Grimaldi et al.[13] made comments describing load management as an important part of the treatment of GTPS while recommending progression and individualization of loading - which our protocol accomplished. Our results aligned with Ganderton et al.[14] randomized trial in that the treatment group had increased improvement with gluteal loading than sham loading exercises, but we showed a greater improvement overall.

Regarding our combined intervention approach, our findings differ from those of Mellor et al.[15] who found no difference between corticosteroid injection and exercise at 52 weeks. This indicates that our combined intervention may bring potential benefits above single-modality interventions. The size of improvement in the HOOS subscales when comparing pre-and post-intervention (19.9 points in Sport/Recreation subscale and 20.4 points for Quality of Life subscale) may reflect considerable functional improvements and certainly improves upon the negative impact of GTPS on work, physical activity, and quality of life that is well documented by Fearon et al.[16] Further, we used general pain scales like most previous studies in patients with GTPS and other tendon injuries. However, the pressure pain threshold measurements we employed provide an objective measure for a reduction in pain sensitivity and define different performance measures different from the GTPS-specific outcome measures still being developed like VISA-G published by Fearon et al. [17a]

Strengths

The study's strengths include a parallel-group, assessor-blinded study design with appropriate randomization and allocation concealment (to minimize selection bias and detect bias). The study's sample size was adequately powered, the retention rate for participants (94.4%) with self-reported levels of exercise was similar across groups (76.3% vs. 72.4%), and all have implications for enhancing internal validity. The use of multiple outcome measures that were validated provided a comprehensive assessment of different domains of GTPS, and the pragmatic nature provides increased external validity as patients were recruited from three major hospitals that represented a range of socioeconomic and health background characteristics.

Limitations

The limitations of our study include not being able to blind the therapists and participants to the interventions possible due to the nature of the interventions (potential for performance bias). The short follow-up of the study (12 weeks)means that we do not know the long-term effects of the interventions, especially considering GTPS tends to be a chronic condition. While we recorded self-reported adherence to home exercises, this method is usually limited in accuracy due to recall and social desirability biases. While we have standardized the clinical interventions, we did not control for the idiosyncratic patient response to dry needling, for example, the level of needle sensitivity in the patient or previous experiences with needling.

Future Directions

Future research could assess the long-term effectiveness of this combined approach by conducting larger follow-ups (6-12 months) similar to Mellor et al.[15] Alternatively, directly compare our combined approach with other established interventions, such as corticosteroid injections or shockwave therapy, to determine comparative effects across treatment options, as was done by Mani-Babu et al.[18] who assessed findings from multiple tendinopathy treatments. Studies examining different dosages of dry needling and variations to the progressive loading will help refine the treatment parameters; additionally, cost-effectiveness studies would assist in informing healthcare benefits decision-making, critical considering the potential healthcare costs of chronic GTPS as demonstrated by Fearon et al.[17] Finally, similar methodologies were utilized by Ganderton et al. has done with GTPS, there may

be an opportunity for developing predictive models for treatment responses to tailor clinicians' decisions to patient characteristics.

CONCLUSION

A combined approach of dry needling and progressive loading exercises is more effective than standard care for GTPS, with benefits across multiple outcome domains exceeding clinically important thresholds. Our findings build on the current literature by demonstrating that this combined intervention offers faster and better improvement than previously studied single-modality approaches. This evidence supports considering this combined intervention as a first-line treatment for GTPS patients, especially those wanting to improve physical function and quality of life.

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None.

Author Contributions

Satish Kumar and **Noel S. Chatla** conceptualized the study and led the methodology design. **Perkash Lal** contributed to data analysis and interpretation. **Aneela Shoukat** and **Noor-ul-Ain Sohail** were responsible for data collection and project administration. **Komal** assisted with literature review and manuscript drafting. All authors reviewed and approved the final manuscript.

Ethical Approval

This study received approval from the Institutional Ethical Review Committee (Ref No: SIRC/2024/1783) of Shifa International Hospital, Islamabad, Pakistan.

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None.

Conflict of Interests

None.

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