



**PROGRAMA DE PÓS-GRADUAÇÃO EM DESENVOLVIMENTO HUMANO E
TECNOLOGIAS**

**EXERCÍCIOS DE CONTROLE MOTOR VERSUS EXERCÍCIOS GERAIS NA
SÍNDROME DOLOROSA DO TROCÂTER MAIOR: ENSAIO
CONTROLADO ALEATORIZADO**

GUILHERME THOMAZ DE AQUINO NAVA

**PROGRAMA DE PÓS-GRADUAÇÃO EM DESENVOLVIMENTO HUMANO E
TECNOLOGIAS**

**EXERCÍCIOS DE CONTROLE MOTOR VERSUS EXERCÍCIOS GERAIS NA
SÍNDROME DOLOROSA DO TROCÂTER MAIOR: ENSAIO CONTROLADO
ALEATORIZADO**

GUILHERME THOMAZ DE AQUINO NAVA

Orientador: Marcelo Tavella Navega
Coorientadora: Angélica Mércia Pascon Barbosa
Coorientadora: Cristiane Rodrigues Pedroni

Tese apresentada ao Instituto de Biociências do Câmpus de Rio Claro, Universidade Estadual Paulista, como parte dos requisitos para obtenção do título de doutor em Desenvolvimento Humano e Tecnologias.

N316e

Nava, Guilherme Thomaz de Aquino

Exercícios de controle motor versus exercícios gerais na síndrome dolorosa do trocânter maior: Ensaio controlado aleatorizado / Guilherme Thomaz de Aquino Nava.

-- Rio Claro, 2023

111 p.

Tese (doutorado) - Universidade Estadual Paulista (Unesp), Instituto de Biociências, Rio Claro

Orientador: Marcelo Tavella Navega

Coorientadora: Angélica Mércia Pascon Barbosa, Cristiane Rodrigues Pedroni

1. Síndrome dolorosa do trocânter maior. 2. Exercício. 3. Tendinopatia glútea. 4. Dor. 5. Reabilitação. I. Título.

Sistema de geração automática de fichas catalográficas da Unesp. Biblioteca do Instituto de Biociências, Rio Claro. Dados fornecidos pelo autor(a).

Essa ficha não pode ser modificada.

CERTIFICADO DE APROVAÇÃO

TÍTULO DA TESE: EXERCÍCIOS DE CONTROLE MOTOR VERSUS EXERCÍCIOS GERAIS NA SÍNDROME DOLOROSA DO TROCÂTER MAIOR: ENSAIO CONTROLADO ALEATORIZADO

AUTOR: GUILHERME THOMAZ DE AQUINO NAVA

ORIENTADOR: MARCELO TAVELLA NAVEGA

COORIENTADORA: CRISTIANE RODRIGUES PEDRONI

COORIENTADORA: ANGÉLICA MÉRCIA PASCON BARBOSA

Aprovado como parte das exigências para obtenção do Título de Doutor em Desenvolvimento Humano e Tecnologias, área: Tecnologias nas Dinâmicas Corporais pela Comissão Examinadora:



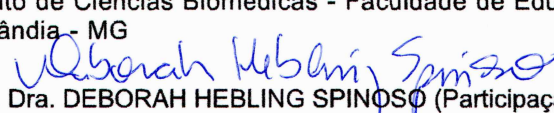
Prof. Dr. MARCELO TAVELLA NAVEGA (Participação Presencial)
Departamento de Fisioterapia e Terapia Ocupacional / UNESP - Faculdade de Filosofia e Ciências de Marília - SP



Profa. Dra. GISELE GARCIA ZANCA (Participação Presencial)
Departamento de Fisioterapia e Terapia Ocupacional / UNESP - Faculdade de Filosofia e Ciências de Marília - SP

Prof. Dr. FÁBIO VIADANNA SERRÃO (Participação Virtual)
Departamento de Fisioterapia / Universidade Federal de São Carlos - SP

Profa. Dra. LILIAN RAMIRO FELICIO (Participação Virtual)
Instituto de Ciências Biomédicas - Faculdade de Educação Física e Fisioterapia / Universidade Federal de Uberlândia - MG



Profa. Dra. DEBORAH HEBLING SPINOSO (Participação Presencial)
Departamento de Fisioterapia e Terapia Ocupacional / UNESP - Faculdade de Filosofia e Ciências de Marília - SP

Rio Claro, 17 de abril de 2023

Dedicatória

Esta tese é dedicada aos meus pais Francisca Helena Thomaz de Aquino Nava e William Roberto Nava que sempre foram meus maiores incentivadores, que me ensinaram a importância do conhecimento e que nunca mediram esforços para que eu pudesse alcançar todos os meus objetivos.

Dedico também a minha companheira de vida, Caroline Baldini Prudencio, por dividir comigo todos os bons e maus momentos desde 2010. Que continuemos seguindo a mesma trajetória sempre com muito companheirismo.

Agradecimentos

Não poderia deixar de agradecer meu orientador Prof. Dr. Marcelo Tavella Navega pelos oito anos de parceria entre mestrado e doutorado, que me propiciou amadurecimento não somente no âmbito acadêmico, mas também pessoal. Agradeço por abraçar todas as ideias e apoiar as oportunidades que surgiram.

À minha coorientadora Profa. Dra. Angélica Mércia Pascon Barbosa que me acompanha desde a graduação, como minha orientadora de TCC e com quem dividi muitos momentos importantes. Agradeço também a Profa. Dra. Cristiane Rodrigues Pedroni pela parceria em diversos projetos e por estar sempre presente para viabilizar o estudo.

Ao Prof. Paul W. Hodges, apesar do pouco tempo de contato que tivemos, agradeço os ensinamentos e, principalmente, a oportunidade e o acolhimento do outro lado do mundo, lembro da ansiedade que foi a espera pela carta de aceite que veio poucos dias antes do encerramento do edital. Aos amigos que fiz na Austrália, que dividiram comigo os prazeres e as angústias de estar tão distante de casa.

Aos professores que tive o prazer e a honra de conviver e de ser aluno nesses tantos anos dentro da Universidade, que dedicam/dedicaram a vida a ensinar com prazer e compreensão. Ser professor é sem dúvida a profissão mais importante que existe e, a capacidade de instigar esta vontade no outro, mesmo num país que não valoriza isto, é uma habilidade que poucos tem.

Agradeço muito minha família, que é muito unida e foi sempre muito presente, especialmente meu avô e tio Leonel, que sempre me apoiaram, se interessaram e participaram da minha vida. A todos os meus tios, tias, primos e primas que são tantos que correria o risco de esquecer alguém ao tentar enumerá-los, mas que são fundamentais na minha vida.

Agradeço a todos os meus amigos, da graduação, da pós-graduação ou mesmo da vida, que sorte temos por termos nos encontrado, tenho em mim um pedaço de cada um de vocês.

Agradeço a secretaria municipal de saúde, em especial o Dr. Marcos Antonio Giroto, por autorizar a captação de voluntárias dentro das Unidades Básicas de Saúde. Aos funcionários da Unesp de Marília e Rio Claro, obrigado por tornar tudo possível. Ao Marília notícia, perfil de notícias e mídia do Instagram, dirigido pelo jornalista Gabriel Tedde, que noticiou diversas vezes nosso estudo e contribuiu imensamente para alcançarmos a amostra necessária. Ao médico ortopedista Flávio Maldonado, que entendeu a importância do estudo, e nos confiou suas pacientes.

Agradeço a todas as voluntárias desta e de todas as pesquisas, que entendem a importância, que se importam, que saem de casa, muitas vezes longe, para nos ajudar, sem vocês nada disto seria possível. Por fim, o presente trabalho foi realizado com apoio da Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Código de Financiamento 001.

Epígrafe

Os que se encantam com a prática sem a ciência são como os timoneiros que entram no navio sem timão nem bússola, nunca tendo certeza do seu destino.

Leonardo da Vinci

Trajetória acadêmica

A minha história com a pesquisa iniciou-se na graduação em fisioterapia na UNESP de Marília (2009-2012), onde participei de projetos de extensão e de pesquisa em diversas áreas como cardiologia, respiratória e em saúde da mulher. Meu trabalho de conclusão de curso na área da saúde da mulher, resultou no artigo intitulado “*Evolution of female urinary continence after physical therapy and associated factors*”.

Posteriormente, decidi ampliar meus conhecimentos cursando a especialização em Reeducação funcional da Postura e do Movimento (2013-2014) no Hospital das Clínicas da Faculdade de Medicina da Universidade de São Paulo (HCFMUSP). Este foi um período bastante intenso da minha vida, precisei me mudar para São Paulo e iniciei uma especialização muito densa, com carga horária de quase 2.000 horas em apenas um ano. Apesar das dificuldades, considero que a especialização foi um divisor de águas e foi neste momento que tive interesse em ingressar no mestrado e estudar situações que via na clínica. Quando retornei para minha cidade em 2014 comecei a trabalhar como Fisioterapeuta na empresa Unimed.

Em 2015 iniciei o mestrado no Programa de Pós-Graduação em Desenvolvimento Humano e Tecnologias do Instituto de Biociências da Unesp de Rio Claro, sob supervisão do Prof. Dr. Marcelo Tavella Navega. A dissertação resultou na publicação dos artigos “*The trunk muscles behavior in women with low back pain in the test of flexion and extension of the trunk*”, “*Influence of pain in strength, resistance and recruitment of trunk muscles*”, além de outro já submetido. No mesmo período ministrei aulas no curso de Fisioterapia na Unesp – Marília como professor bolsista. Concomitante, cursei especialização em Osteopatia estrutural (2015-2017). Esta etapa foi necessária pois não queria permanecer somente na área acadêmica, tinha vontade de manter meus atendimentos e senti falta de uma especialização que me mantivesse atualizado com

relação as terapias manuais. Na mesma época do mestrado e da especialização em osteopatia, comecei meus atendimentos no Instituto físico e cognitivo, clínica que mantive por 3 anos (2016-2019) e que tive o prazer de dividir com fonoaudiólogas, terapeutas ocupacionais, psicólogas e fisioterapeutas.

Após o mestrado, tive oportunidade de continuar com o doutorado novamente com o Prof. Marcelo, agora com um novo desafio, desenvolver um ensaio controlado aleatorizado. O objetivo do doutorado foi comparar duas abordagens para o tratamento de mulheres com síndrome dolorosa do trocanter maior. Ingressei no doutorado em 2018 e, desde o início, conseguir a amostra necessária para o estudo foi bastante desafiador. Logo no segundo ano de doutorado, surgiu a oportunidade do doutorado sanduíche financiado por meio do edital da Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) do Programa Institucional de Internacionalização (CAPES-Print). Tive oportunidade vivenciar, durante seis meses, a experiência de estar na The University of Queensland “*Centre for Clinical Research Excellence in Spinal Pain, Injury and Health*”, liderado pelo professor Paul W. Hodges, que é um dos principais pesquisadores na área de fisioterapia a nível mundial.

Durante meu intercâmbio conheci grandes pesquisadores e, com certeza, está foi uma das experiências mais enriquecedoras da minha vida. Tive a oportunidade de analisar dados parciais de eletromiografia e aprofundar meus conhecimentos em relação a coleta e análise de dados participando de coletas com os pesquisadores Wolbert van den Hoorn, Bill Vicenzino, Paul W. Hodges e Manuela Besomi, sendo que desta parceria foi publicado o artigo “*Influence of transducer orientation on shear wave velocity measurements of the iliotibial band*”. Além disso, tive contato com o sistema de aquisição de imagem Vicon e o software optitrack. Infelizmente, devido a pandemia do coronavírus, o doutorado sanduíche foi prematuramente encerrado com 1 mês de antecedência.

Após o retorno ao Brasil, em plena pandemia (abril de 2020), não consegui dar continuidade as coletas, que ficaram paradas até setembro de 2020, quando consegui reiniciar. Além disso, no retorno ao Brasil, consegui uma bolsa da capes CAPES/DS (demanda social), que proporcionou a continuidade do projeto num momento tão difícil do Brasil e do mundo. Cabe ressaltar que havia coletado 13 voluntárias antes do início da pandemia e 47 foram coletadas durante a pandemia (período entre setembro de 2020 e março de 2022), sendo que esta situação somou mais um percalço dentre tantos desafios nestes mais de 4 anos de doutorado.

Também após meu retorno do intercâmbio, convidei as professoras Angélica Mércia Pascon Barbosa e Cristiane Rodrigues Pedroni para fazerem parte do projeto como coorientadoras, sendo que o ingresso delas foi essencial para a continuidade do estudo. Com esta parceria, fui convidado a fazer parte do Diamater Study Group, que estuda a tríade entre miopatia do assoalho pélvico, a incontinência urinária e o diabetes gestacional, além de diversos outros projetos de pesquisa.

Para finalizar, durante estes 8 anos de dedicação a pesquisa pude vivenciar as atividades que compõem a universidade pública e privada. Participei do ensino, por meio dos estágios docência realizados na disciplina de estágio supervisionado em fisioterapia nas disfunções musculoesqueléticas na Unesp de Marília, e, mais recentemente, como docente da Faculdade de Ensino Superior do Interior Paulista.

A nível de extensão participei do projeto RENOVE de auxílio da Professora Angélica. Em nível de pesquisa, participei como ouvinte de 35 congressos/simpósio/encontros nacionais e internacionais, 18 cursos de formação complementar, proferi palestras, ministrei um curso sobre eletromiografia, organizei 3

congressos, participei de comissão julgadora de congresso, participei de 22 bancas de TCC nível graduação, fui autor ou coautor de 10 resumos de trabalhos apresentados em congresso, 14 trabalhos publicados em anais de congresso, 3 prêmios em congressos nacionais e internacionais como coautor, 19 artigos publicados como autor ou coautor e 5 artigos em processo de submissão como autor ou coautor. Obtendo a aprovação na defesa da tese de doutorado, a trajetória continuará.

RESUMO

Introdução: A síndrome dolorosa do trocanter maior (SDTM) refere-se à dor na região do trocânter maior do fêmur. A SDTM está associada à fraqueza e ao controle deficitário da pelve. Sabe-se que as pessoas com SDTM se beneficiam de exercício físico, mas não há estudos que tenham comparado um treinamento com foco no controle motor e exercícios gerais. O objetivo deste estudo foi comparar um protocolo de controle motor e um protocolo de exercícios gerais com relação a dor média, antes e após 8 e 60 semanas de tratamento. **Métodos:** O estudo foi aprovado pelo Comitê de Ética em Pesquisa (CAAE: 87372318.1.0000.5406) e registrado prospectivamente no Registro Brasileiro de Ensaios Clínicos (RBR-37gw2x). Sessenta mulheres foram randomizadas em dois grupos, o grupo controle motor (GCM) e o grupo exercícios gerais (GEG). O desfecho primário foi a intensidade média da dor. Os desfechos secundários foram efeito global percebido (EGP), força muscular, catastrofização da dor, cinesiofobia, sensibilização central e qualidade de vida. **Resultados:** Nenhuma interação significativa de tempo x grupo foi observada em relação à intensidade média da dor em 8 semanas (MD: -0,06; IC 95% -1,41 a 1,29; $p = 0,92$, tamanho do efeito = 0,02) ou 60 semanas (MD: -0,75; IC 95% -2,35 a 0,83; $p=0,34$, tamanho do efeito= 0,24). Com relação aos desfechos secundários, somente o desfecho força muscular apresentou diferença estatisticamente significativa na comparação entre os grupos, especificamente na reavaliação dos músculos extensores do quadril no lado sem dor (MD: 0,1; IC 95% 0,0004 a 0,2; $p=0,04$; tamanho do efeito = 0,54). **Conclusão:** O protocolo de controle motor não foi superior ao protocolo de exercícios gerais na melhora da intensidade média da dor em 8 e 60 semanas de acompanhamento em mulheres com SDTM.

Palavras-chave: Síndrome dolorosa do trocanter maior; Exercício; Tendinopatia glútea; Dor; Reabilitação

ABSTRACT

Introduction: Greater trochanter pain syndrome (GTPS) refers to pain in the greater trochanter region of the femur. GTPS is associated with weakness and poor control of the pelvis. It is known that people with GTPS benefit from physical exercise, but there are no studies that have compared training focused on motor control and general exercises. The aim of this study was to compare a motor control protocol and a general exercise protocol with respect to average pain, before and after 8 and 60 weeks of treatment. **Methods:** The study was approved by the Research Ethics Committee (CAAE: 87372318.1.0000.5406) and prospectively registered in the Brazilian Registry of Clinical Trials (RBR-37gw2x). Sixty women were randomized into two groups, the motor control group (MCG) and the general exercise group (GEG). The primary outcome was mean pain intensity. Secondary outcomes were perceived global effect (GPE), muscle strength, pain catastrophizing, kinesiophobia, central sensitization, and quality of life. **Results:** No significant time x group interactions were observed regarding mean pain intensity at 8 weeks (MD: -0.06; 95% CI -1.41 to 1.29; $p = 0.92$, effect size = 0.02) or 60 weeks (MD: -0.75; 95% CI -2.35 to 0.83; $p = 0.34$, effect size = 0.24). Regarding the secondary outcomes, only the muscle strength outcome showed a statistically significant difference when comparing the groups, specifically in the reassessment of the hip extensor muscles on the side without pain (MD: 0.1; 95% CI 0.0004 to 0.2 ; $p = 0.04$; effect size = 0.54). **Conclusion:** The motor control protocol was not superior to the general exercise protocol in improving mean pain intensity at 8 and 60 weeks of follow-up in women with GTPS.

Keywords: Greater trochanteric pain syndrome; Exercise; Gluteal tendinopathy; Pain; Rehabilitation

Sumário

Contextualização

Definição de dor crônica e tratamento não farmacológico baseado em evidências: uma visão abrangente.....	16
Aspectos anatômicos e biomecânicos da pelve, quadril e fêmur.....	18
A síndrome dolorosa do trocânter maior.....	21
Modelo patomecânico	
Respostas fisiológicas do tendão à carga.....	22
Influência da posição da articulação.....	23
Fatores musculares e interação com a posição da articulação.....	23
Fatores ósseos e a interação com a posição articular.....	24
Timeline da definição e do tratamento não farmacológico para a SDTM.....	25
Referências.....	30

Artigos

Artigo 1. Motor control exercises versus general exercises for greater trochanteric pain syndrome: A protocol of a randomized controlled trial

Abstract.....	38
Background.....	39
Material and Methods.....	39
Discussion.....	49
References.....	51

Artigo 2. Motor control exercises versus general exercises on pain in women with Greater trochanteric pain syndrome: A randomized controlled trial

Abstract.....	55
Introduction.....	56
Methods.....	57
Results.....	62
Discussion.....	66
Conclusion.....	70
References.....	71

Anexos

Anexo 1. Artigos publicados durante a tese.....	78
Anexo 2. Parecer substanciado do comitê de ética em pesquisa.....	97
Anexo 3. Questionários e escalas.....	101

Apêndices

Apêndice 1. Termo de Consentimento Livre e Esclarecido.....	109
Apêndice 2. Ficha de avaliação.....	111

CONTEXTUALIZAÇÃO

Definição de dor crônica e tratamento não farmacológico baseado em evidências: uma visão abrangente

Em 2020, a Associação Internacional para o Estudo da Dor (The International Association for the Study of Pain – IASP) atualizou a definição de dor para “uma experiência sensitiva e emocional desagradável associada, ou semelhante àquela associada, a uma lesão tecidual real ou potencial”(1).

Até 2020, o diagnóstico de dor crônica não estava realmente representado na classificação internacional de doenças(2,3), sendo que só foi adicionado como um “MeSH term” no MEDLINE em janeiro de 2012, que pode demonstrar pequena proporção de pesquisas destinadas a esta condição(4). Uma cooperação entre a organização mundial da saúde e um grupo vinculado a IASP, desenvolveram um sistema de classificação para uma ampla gama de contextos(3). Seis subgrupos foram criados, sendo a dor crônica secundária uma delas.

A ciência, atualmente, considera a percepção da dor como complexo sistema motivacional conectado que minimiza o dano por meio de respostas defensivas fisiológicas e comportamentais de acordo com a identificação de que o corpo está em perigo(5,6). Estas respostas defensivas são, geralmente, adaptativas, uma vez que frequentemente protegem a integridade do corpo(6). O objetivo desses mecanismos de percepção é de atuar como parte de um sistema de resposta que alerta e prepara o organismo para enfrentar situações de perigo(5,6).

Pessoas com dor aprendem a identificar situações prejudiciais, e como consequência, adaptam-se para evitar ou minimizar seus impactos. Entretanto, a persistência da dor, pode tornar o indivíduo mal adaptado, o que pode resultar em incapacidade e sofrimento(4,7). A dor crônica pode gerar prejuízos na habilidade de identificar de forma apropriada situações que realmente são ameaçadoras ao organismo,

que ativa o sistema protetivo quando não é necessário(8–10).

Uma revisão das questões atuais no tratamento da dor crônica sugere que os profissionais de saúde tradicionalmente se concentram em visões biomédicas, e utilizam de fármacos em primeiro lugar e, às vezes, não abordam possíveis opções não farmacológicas, como atividade física e mudança de atitudes em relação à dor crônica(11).

As orientações sugerem que o aconselhamento sobre estilo de vida é importante: por exemplo, as diretrizes de osteoartrite do National Institute for Health and Care Excellence (NICE) afirmam que “o exercício deve ser o tratamento central, independentemente da idade, comorbidade, gravidade da dor e incapacidade(12). O exercício deve incluir: fortalecimento muscular local e condicionamento aeróbico geral”, entretanto, as evidências atuais sugerem que simplesmente dar um conselho individual para se exercitar é insuficiente para provocar mudanças significativas(12) e que uma intervenção mal prescrita que não considera as condições do indivíduo, o estado atual de saúde, o condicionamento físico e a progressão gradual, pode causar eventos adversos como picos de dor(13). Esta informação sugere que intervenções supervisionadas e estruturadas podem ser mais interessantes(4).

Embora as evidências para a eficácia de intervenções por meio de exercício sejam de quantidade e qualidade variáveis, as diretrizes da Scottish Intercollegiate Guideline Network (SIGN) de 2013 sobre o manejo da dor crônica, recomendam o uso de exercícios, com base em evidências extraídas de ensaios controlados aleatorizados, afirmando que “exercícios e terapias por meio de exercícios, independentemente de sua forma, são recomendadas no manejo de pacientes com dor crônica”(14).

Os exercícios podem ter benefícios específicos na redução da gravidade da dor crônica(14). Estudos revelaram que uma única sessão de exercício aumenta a produção

de opióides endógenos, diminuindo a nocicepção em animais e humanos, e exercícios repetidos diminuem a nocicepção a longo prazo(15). Além disso, exercícios resistidos, podem melhorar a capacidade de sustentação óssea e cartilaginosa por meio do aumento da força muscular ao redor da articulação, com potencial para aliviar a dor(16,17).

As evidências sugerem que o amplo espectro de atividades físicas e intervenções de exercícios avaliados (aeróbico, força, flexibilidade, amplitude de movimento e programas de treinamento de core ou equilíbrio, bem como ioga, Pilates e tai chi) são potencialmente benéficos para as tendinopatias, embora as evidências sejam de baixa qualidade e inconsistentes(4). Os eventos adversos mais comumente relatados foram aumento da sensibilidade ou dor muscular, que cedeu após várias semanas da intervenção(4). A atividade física e o exercício podem diminuir a gravidade da dor, bem como melhorar a função física e a qualidade de vida(4,17).

Aspectos anatômicos e biomecânicos da pelve, quadril e fêmur

A união dos três ossos ílio, ísquio e púbis formam um osso inominado(18–20). Os ossos inominados direito e esquerdo conectam-se anteriormente na região da sínfise púbica e, posteriormente, na região do sacro, e as conexões entre esses ossos formam um anel osteoligamentar completo, conhecido como pelve(18–21).

O ílio é o maior dos três ossos pélvicos e está localizado superiormente em relação ao ísquio e ao púbis(19). A parte superior do ílio é conhecida como crista ilíaca e, anteriormente, a crista ilíaca termina na espinha ilíaca ântero-superior e, posteriormente, na espinha ilíaca pósterio-superior(18–21).

O ísquio é a porção posterior inferior do osso do quadril. Na junção posteromedial, o osso tem uma projeção chamada espinha isquiática – a concavidade entre essa espinha e a espinha ilíaca posterior inferior forma a incisura isquiática maior e - a concavidade

entre esta coluna e o ramo inferior, é chamada de incisura isquiática menor(18,19,21).

O púbis é a porção inferior e anterior do osso do quadril e o ramo inferior do púbis se funde com o ramo inferior do ísquio(19,20). O púbis e o ísquio juntos formam o forame obturador(18,19).

A pelve apresenta funções biomecânicas importantes, a primeira delas é que nela se inserem músculos grandes dos membros inferiores e do tronco, além disso, durante a sedestação, a pelve absorve e transmite todo o peso da parte superior do corpo para as tuberosidades isquiáticas(18–20). Na ortostase e na marcha a pelve transmite para os membros inferiores o peso da parte superior do corpo e, associada aos músculos e aos tecidos conectivos do assoalho pélvico, a pelve suporta os órgãos envolvidos com a função intestinal, vesical e reprodutiva(18–20).

O quadril consiste na articulação entre a grande cabeça esférica do fêmur e o profundo soquete côncavo proporcionado pelo acetábulo da pelve(18,22,23). Os 3 ossos da pelve contribuem para a formação do acetábulo, sendo que o ílio e o ísquio formam 75%, enquanto o púbis contribui com os 25% restantes (18,20). A extremidade proximal do fêmur, a cabeça femoral, é convexa e projeta-se medial e anteriormente, articulando-se ao acetábulo(18,20,22,23).

A função primária da articulação do quadril é fornecer suporte dinâmico ao peso do corpo/tronco enquanto facilita a transmissão de força e carga do esqueleto axial para as extremidades inferiores, permitindo mobilidade(18,20,22). A articulação do quadril conecta as extremidades inferiores com o esqueleto axial e permite o movimento em três planos principais, flexão e extensão, rotação interna e externa e abdução e adução, além do movimento, a articulação do quadril facilita a sustentação de peso(18,22).

A estabilidade do quadril decorre da profundidade do acetábulo, que pode abranger quase toda a cabeça do fêmur, além disso, há um colar fibrocartilaginoso

adicional ao redor do acetábulo, o labrum, que auxilia na transmissão de carga, na manutenção da pressão negativa, no aumento da estabilidade da articulação do quadril e na regulação das propriedades hidrodinâmicas do líquido sinovial(18,20–22).

O fêmur, que se insere no acetábulo para a formação da articulação do quadril, é o osso mais longo, mais pesado e mais forte do corpo humano, na extremidade proximal, o colo em forma de pirâmide, fixa a cabeça esférica no ápice e o eixo cilíndrico na base(18,20,21,23). A principal função do fêmur é o suporte de peso e a estabilidade durante a marcha(23). A cabeça do fêmur é apontada em direção medial, superior e ligeiramente anterior(18,20,23). O ligamento redondo conecta o acetábulo à fóvea, que é um buraco na cabeça do fêmur, há também 2 saliências ósseas proeminentes, o trocânter maior e o trocânter menor, que se ligam aos músculos que movem o quadril e o joelho(18,20,23).

O trocânter maior do fêmur é uma grande projeção quadrangular na junção do colo do fêmur com a epífise proximal(24). É o ponto de inserção dos tendões dos músculos abdutores e facilita a relação entre o movimento de abdução e as bursas da região(24,25). Há aproximadamente 20 bursas na região trocantérica do quadril, sendo que 3 delas, a bursa do músculo glúteo mínimo, a bursa subglútea do músculo glúteo médio e a bursa subglútea do músculo glúteo máximo, estão presentes na maioria dos indivíduos(24–26).

Os músculos glúteo médio e mínimo fazem parte do mecanismo abdutor da articulação do quadril(24,27). São inervados pelo nervo glúteo superior, L5 e S1(24). A função primária da parte posterior do glúteo médio e glúteo mínimo é estabilizar a cabeça do fêmur no acetábulo durante o movimento e a marcha(24). As fibras anterior e média do glúteo médio têm uma tração cefálica auxiliando no início da abdução(24).

A síndrome dolorosa do trocânter maior

A síndrome dolorosa do trocânter maior (SDTM) ou síndrome dolorosa do grande trocânter é um termo genérico, ou seja, utilizado para descrever diversas alterações que podem acometer a região do quadril(25,28–31). SDTM é definida como dor ou sensibilidade na região lateral do quadril, próximo ou sobre o trocânter maior do fêmur(29–31). Trata-se de uma condição extra articular, sendo a tendinopatia dos músculos glúteo médio e/ou mínimo, os achados clínicos mais comuns(17,26,27,29,30).

A SDTM é mais prevalente em mulheres, com uma relação de 4:1 quando comparado aos homens, e afeta principalmente indivíduos com idade acima de 40 anos(17,24–28,32). Estima-se que 10 a 25% da população desenvolverá algum tipo de dor na região lateral do quadril(24–26,28,29,31). A SDTM impacta diretamente na piora da qualidade de vida, o que é semelhante aos achados em indivíduos com osteoartrite de quadril grave(31,33).

As mulheres apresentam mecanismos que podem influenciar no aparecimento da SDTM, como menores inserções tendíneas glúteas no fêmur, braço do momento glúteo mais curto, fraqueza do glúteo médio, largura do quadril maior comparado ao restante do corpo e menor angulação do colo femoral(24,25,28). Estes fatores de risco podem favorecer o aumento da compressão na região do trocânter maior do fêmur, entretanto, fatores como idade, sexo feminino, dor ipsilateral na região do trato iliotibial, osteoartrite de joelho ou quadril, obesidade, dor lombar e atividades esportivas específicas também podem favorecer o aparecimento da SDTM(24–26).

A etiologia da tendinopatia é proposta como multifatorial com componentes intrínsecos e extrínsecos(24,32). Diferentes teorias de tendinopatia têm sido sugeridas, a maioria discute cargas mecânicas anormais e respostas celulares alteradas(24). A tendinopatia glútea é a condição mais frequentemente encontrada em indivíduos com

SDTM e é a mais prevalente de todas as tendinopatias que podem acometer os membros inferiores(17,24,27,32).

Modelo patomecânico da SDTM

Respostas fisiológicas do tendão à carga

A carga mecânica é um potente impulsionador dos processos biológicos que ocorrem dentro de um tendão, e estes, por sua vez, determinam sua forma estrutural e capacidade de suportar cargas(24,27,32). A todo momento os tendões passam por processos catabólicos e anabólicos e, sob condições de carga normal, estes processos estão equilibrados e o tendão funciona em homeostase, todavia, este equilíbrio pode ser perturbado pelo tipo, intensidade e frequência da carga(27).

Uma carga pode ser aplicada a um tendão longitudinal às suas fibras de colágeno (tensão ou carga de tração) ou perpendicular à linha das fibras (compressão)(27). Aumentos graduados na carga de tração com recuperação e tempo de adaptação adequados induzem um efeito anabólico, com subsequente aumento da capacidade do tendão de suportar carga, entretanto, um rápido aumento na intensidade e/ou frequência da carga de tração pode levar à falha de adaptação e a um efeito catabólico. O catabolismo também resulta da falta de carga de tração (carga abaixo do normal) e compressão(27).

No nível celular, a carga abaixo do normal e a compressão induzem a expressão de enzimas catabólicas, que quebram o colágeno tipo 1, e aumentam a expressão dos tenócitos de grandes proteoglicanos, que clivam as fibras de colágeno(24,27). A degradação da matriz e as mudanças no comportamento dos tenócitos reduzem a capacidade de carga e predisõem a lesões em cargas de tração relativamente baixas, todavia, este processo não ocorre igualmente em todo o tendão, desta forma é seguro realizar exercícios e, como consequência, ter respostas benéficas(24,27).

Influência da posição da articulação

Os tendões dos músculos glúteo médio e mínimo, assim como as bursas presentes na mesma região, podem sofrer compressão pelo trato iliotibial na inserção no trocânter maior do fêmur(18,27). O aumento da angulação em adução do quadril aumenta as forças compressivas na região do trocanter maior, que em 40° de adução pode chegar a 106 Newtons(34).

Diversas são as atividades e movimentos do dia a dia que podem aumentar a compressão na região devido ao movimento de adução do quadril, por exemplo, permanecer em pé com o peso somente sobre uma perna sem alinhamento pélvico, cruzar as pernas, correr ou mesmo caminhar com os pés tocando a linha média, indicando movimento excessivo em adução(27).

Maiores amplitudes de flexão do quadril também podem modificar a tensão do trato iliotibial devido à junção do trato iliotibial com a fáscia glútea e na fáscia lombosacral, que pode gerar compressão dos tendões dos músculos glúteo médio e glúteo mínimo(35,36). Como consequência, uma das principais queixas em quem apresenta tendinopatia glútea é a dor ao sentar-se por muito tempo, dor e dificuldade em se levantar, principalmente se estiverem sentados com mais de 90° de flexão do quadril. Associar o posicionamento sentado com joelhos cruzados ou aduzidos em um assento baixo, aumenta ainda mais a tensão do trato iliotibial e consequente aumento da carga no tendão do músculo glúteo médio(27).

Aspectos cinesiológicos e biomecânicos

A manutenção da abdução do quadril ocorre pela ativação síncrona dos músculos abdutores do quadril, músculo glúteo médio e glúteo mínimo, assim como, ativação dos músculos que tensionam o trato iliotibial, músculo tensor da fascia lata, porção superior e

abdução do glúteo máximo e o músculo vasto lateral(27). Kummer(37) demonstrou que 70% do controle pélvico durante o apoio unipodal era mantido pelos músculos abdutores, enquanto os tensores do trato iliotibial contribuíram com os 30% restantes(27,37), entretanto, Sutter e colaboradores(38) demonstraram que o músculo tensor da fascia lata pode estar hiperativado na presença de lesão do tendão abdutor. Embora não esteja claro se estas alterações precedem ou resultam da tendinopatia, a hiperativação dos músculos tensionadores do trato iliotibial geram maior compressão trocantérica na adução do quadril(27).

Fatores ósseos e a interação com a posição articular

A força de compressão produzida pelo trato iliotibial nos tendões e bursas depende da angulação do colo femoral(18,27). Numa angulação típica de 125-128° o trato iliotibial gera uma força de compressão de aproximadamente 656 newtons no trocânter maior do fêmur(34), que pode aumentar para 997 newtons numa angulação menor 115° (coxa vara)(18,27,34). Além da angulação do colo femoral, Viradia e colaboradores(39) demonstraram recentemente que a diferença entre a distância das cristas ilíacas e dos trocânteres maiores foi maior em indivíduos com dor lateral do quadril (diferença média de 28 mm) do que em uma população controle sem dor (diferença média de 17 mm)(27,39). A diminuição da angulação do colo femoral pode colaborar para o aumento da distância entre os trocânteres maiores e, conseqüentemente, irá favorecer a compressão do tendão do glúteo pelo trato iliotibial(27).

Timeline da definição e do tratamento não cirúrgico para a SDTM

A SDTM nem sempre foi descrita desta forma. Inicialmente apresentada como bursite trocantérica por Stegemann em 1923, era considerada a causa primária das dores na região lateral do quadril, entretanto, era conhecida como “great mimicker” ou “grande imitadora”, devido a diversas vezes ser confundida com outras condições(25,30,31). Além disso, a utilização do sufixo “ite”, como nas bursites ou tendinites, presume a existência de sinais inflamatórios, como dor, edema, rubor, calor e perda da função, que não estão presentes em pessoas com esta condição, principalmente nos casos crônicos, em que os sinais típicos da inflamação já não são aparentes(25,27,30).

Em 1931 a mesma condição foi descrita por LeCocq como bursite peritrocantérica(40). Leonard em 1958 propôs o uso do termo síndrome trocantérica e posteriormente o uso do termo SDTM para se referir a sintomas nas proximidades do trocânter maior do fêmur(41,42). O termo SDTM caracteriza melhor a condição porque dor ou sensibilidade na região do trocânter maior, glúteo e lateral da coxa podem estar associadas a inúmeras outras causas como, tendinopatia e/ou tendinite dos músculos glúteo médio ou mínimo, rupturas musculares destes mesmos músculos, pontos gatilhos, distúrbios do trato iliotibial ou síndrome do ressalto do quadril(25,26,30).

Apesar das evidências mencionadas indicarem que há curiosidade sobre o assunto a muito tempo, somente nas últimas duas décadas foram conduzidos ensaios controlados aleatorizados e revisões sistemáticas e, estes, serão apresentados a seguir.

Em 2012 Del Buono e colaboradores(26) publicaram uma revisão sistemática com o intuito de sumarizar as principais evidências sobre tratamento da SDTM(26). Foram avaliados 14 estudos (1 estudo prospectivo, 2 ensaios controlados aleatorizados e 11 estudos retrospectivos) detalhando os principais desfechos de pacientes que passaram por tratamentos conservadores (injeção de corticosteroide, terapia por ondas de choque ou

exercícios domiciliares), ou cirúrgicos (cirurgia aberta, artroscopia ou endoscopia para reparo do glúteo)(26). O estudo de Rompe et al(43) que buscou comparar injeção de corticosteroide, exercícios domiciliares e aplicação de ondas de choque, demonstrou que a injeção de corticosteroides foi mais efetiva após 1 mês de tratamento, enquanto a terapia por ondas de choque foi mais eficiente após 4 meses, todavia, após 15 meses os exercícios domiciliares foram mais efetivos para a melhora da dor(43). Quanto aos tratamentos cirúrgicos, todos os estudos eram séries de casos pequenos, que os tornam pouco confiáveis cientificamente(26). Em suma, a eficácia das várias modalidades de tratamento deve ser testada em ensaios controlados randomizados cuidadosamente conduzidos(26).

Em 2016 Reid(24) publicou nova revisão sistemática com o objetivo de sumarizar as principais evidências sobre tratamento da SDTM. Foram incluídos 7 estudos, sendo 4 deles ensaios controlados aleatorizados, e 3 estudos de coorte(24). O artigo traz que não há um protocolo definitivo baseado em evidência para o tratamento da SDTM, todavia, as alternativas conservadoras são o padrão ouro com chances de sucesso maior que 90%(24). Apesar da alta incidência da SDTM, ainda há pouca evidência sobre tratamentos de alta qualidade disponível. O estudo de Rompe et al(43), citado anteriormente, demonstra superioridade do exercício domiciliar, após 15 meses de tratamento, para diminuição da intensidade da dor(43). Cohen e colaboradores(44) mostraram que não houve diferença significativa entre injeção de corticosteroide e fluoroscopia, indicando que a injeção de corticosteroide pode estar tratando os tecidos peritrocantéricos em oposição à bursa especificamente, sugerindo evidência de um componente inflamatório da bursa e/ou do tendão(44). Brinks e colaboradores(45) compararam a injeção de corticosteroide com cuidado usual (uso de analgésico quando necessário). Houve superioridade do corticosteroide até 3 meses pós tratamento, entretanto não houve diferenças quando comparadas as terapias após 12 meses de tratamento(45). Ferrari buscou comparar o uso

de órteses customizadas para os pés versus injeção de corticosteroides e concluiu que na reavaliação após 4 meses o uso de órteses customizadas foi mais eficiente na melhora da dor e função(46), entretanto, o estudo apresenta sérios riscos metodológicos, como falta de randomização, falta de cegamento das pessoas envolvidas no estudo, falta de informação dos aspectos éticos e não foi feita a análise por intenção de tratar, que podem contribuir para viés(47). Não foram encontrados estudos avaliando especificamente a fisioterapia para o tratamento da SDTM(24), assim como nenhum estudo buscou avaliar aspectos psicológicos(24). Além disso, esta revisão sistemática conta apenas com uma autora, que dificulta seguir corretamente os protocolos para diminuição do viés metodológico das revisões sistemáticas.

Em 2017 Barratt, Brookes e Newson(32) publicaram uma revisão sistemática com o objetivo de sumarizar as principais evidências sobre tratamentos conservadores para a SDTM, a primeira que incluiu artigos levando em consideração o risco de viés da colaboração Cochrane, que é essencial para permitir análises mais poderosas, garantindo que estudos futuros demonstrem um baixo risco de viés(32). Esta revisão avaliou 8 estudos. Destes, os estudos de Rompe e Ferrari, já citados anteriormente(43,46). A revisão demonstrou que existem poucos estudos de alta qualidade para tratamentos conservadores da SDTM, com apenas um estudo avaliando exercícios domiciliares para o tratamento desta disfunção(43). Em 2019 Clifford e colaboradores(17) publicaram um ensaio controlado aleatorizado com o intuito de comparar exercícios isométricos e isotônicos para os desfechos dor e função, em pessoas com SDTM. Foi feito acompanhamento dos participantes por 4 e 12 semanas. Os resultados demonstraram que não houve diferença entre os grupos(17).

Gazendam e colaboradores(31) publicaram em 2021 uma revisão sistemática com metanálise em rede. Foram avaliados 13 ensaios controlados aleatorizados com o intuito

de comparar aplicação de corticosteroide de forma cega, agulhamento a seco, terapia por ondas de choque, injeção de corticosteroide guiada, aplicação de ácido hialurônico, grupo sem intervenção, aplicação de plasma rico em plaquetas, intervenção por placebo e exercícios estruturados(31). Para o desfecho dor, na reavaliação de um a três meses, a aplicação de plasma rico em plaquetas e terapia por ondas de choque demonstraram redução da intensidade da dor quando comparado a sem tratamento(31). Na reavaliação de 6 a 12 meses, nenhuma das modalidades de tratamento propostas reduziu significativamente os escores de dor comparado a sem tratamento(31). Com relação a função, na reavaliação de um a três meses, os exercícios estruturados foram eficazes quando comparados a sem tratamento(31). Os resultados foram relatados de forma inconsistente em 6 a 12 meses, que dificultou a comparação indireta neste momento(31). Cabe ressaltar que dos 13 estudos somente 3 apresentavam exercício como um braço de tratamento, destes um foi de exercícios domiciliares sem supervisão, um de exercícios versus placebo e um de exercícios versus aplicação de corticosteroide versus grupo sem intervenção(43,48,49).

O presente estudo foi desenvolvido com base nas informações da literatura, que demonstraram os benefícios do exercício físico, discutidos no tópico sobre dor crônica e exercício. Além disso, com relação a etiologia da SDTM, é sabido que o aumento da adução do quadril, seja ela pelo simples posicionamento, por alterações ósseas ou disfunções musculares, aumentam a compressão trocantérica. Por fim, em relação ao histórico da doença, as poucas revisões sistemáticas trouxeram que apesar dos poucos estudos e da baixa qualidade que apresentam, exercícios parecem ser eficientes em diminuir a intensidade da dor a curto, médio e longo prazo(43,48), todavia, o estudo de Ganderton e colaboradores(49) e Clifford e colaboradores(17) não demonstraram diferença em 4, 12 e 52 semanas após o tratamento(17,49).

Sendo assim, até o momento da elaboração do projeto, não foram encontrados estudos avaliando dois braços de tratamento ativos para a SDTM, assim como, não há consenso sobre o melhor exercício e, levando em consideração todas as informações encontradas na literatura, foi elaborado um ensaio controlado aleatorizado. As participantes foram randomizadas para os grupos controle motor e exercícios gerais. O grupo controle motor realizou fortalecimento isométrico e isotônico exclusivo dos músculos abdutores e extensores do quadril e treinamento neuromuscular visando o alinhamento pélvico durante os exercícios, principalmente os unipodais e, juntamente com orientações sobre evitar movimentos de adução exagerados do quadril. O grupo exercícios gerais, que realizou aquecimento com caminhada, fortalecimento e alongamento dos músculos adutores, abdutores, flexores e extensores do quadril, assim como da região inferior do tronco.

Para demonstrar como foi idealizado e realizado o estudo, primeiramente apresentaremos o protocolo de estudo (ARTIGO 1) e posteriormente o artigo com os resultados do desfecho primário e dos desfechos secundários após 8 e 60 semanas de tratamento (ARTIGO 2).

REFERENCIAS

1. DeSantana JM, Perissinotti DMN, Oliveira Junior JO de, Correia LMF, Oliveira CM de, Fonseca PRB da. Definition of pain revised after four decades. Brazilian J Pain [Internet]. 2020;3(3). Available from: https://www.scielo.br/scielo.php?script=sci_issuetoc&pid=2595-319220200050&lng=en&nrm=iso
2. Treede R-D, Rief W, Barke A, Aziz Q, Bennett MI, Benoliel R, et al. A classification of chronic pain for ICD-11. Pain [Internet]. 2015 Jun;156(6):1003–7. Available from: <https://journals.lww.com/00006396-201506000-00006>
3. Treede R-D, Rief W, Barke A, Aziz Q, Bennett MI, Benoliel R, et al. Chronic pain as a symptom or a disease: the IASP Classification of Chronic Pain for the International Classification of Diseases (ICD-11). Pain [Internet]. 2019 Jan;160(1):19–27. Available from: <https://journals.lww.com/00006396-201901000-00003>
4. Geneen LJ, Moore RA, Clarke C, Martin D, Colvin LA, Smith BH. Physical activity and exercise for chronic pain in adults: an overview of Cochrane Reviews. In: Geneen LJ, editor. Cochrane Database of Systematic Reviews [Internet]. Chichester, UK: John Wiley & Sons, Ltd; 2017. Available from: <https://doi.wiley.com/10.1002/14651858.CD011279.pub2>
5. Moseley GL, Vlaeyen JWS. Beyond nociception. Pain [Internet]. 2015 Jan;156(1):35–8. Available from: <https://journals.lww.com/00006396-201501000-00007>
6. Baliki MN, Apkarian AV. Nociception, Pain, Negative Moods, and Behavior Selection. Neuron [Internet]. 2015 Aug;87(3):474–91. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S0896627315005188>
7. Linton SJ, Flink IK, Vlaeyen JWS. Understanding the Etiology of Chronic

Pain From a Psychological Perspective. *Phys Ther* [Internet]. 2018 May 1;98(5):315–24. Available from: <https://academic.oup.com/ptj/article/98/5/315/4925492>

8. Vlaeyen JWS. Learning to predict and control harmful events. *Pain* [Internet].

2015 Apr;156(Supplement 1):S86–93. Available from: <https://journals.lww.com/00006396-201504001-00012>

9. Meulders A, Vlaeyen JWS. Mere Intention to Perform Painful Movements Elicits Fear of Movement-Related Pain: An Experimental Study on Fear Acquisition Beyond Actual Movements. *J Pain* [Internet]. 2013 Apr;14(4):412–23. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S1526590013000072>

10. Sharot T, Garrett N. Forming Beliefs: Why Valence Matters. *Trends Cogn Sci* [Internet]. 2016 Jan;20(1):25–33. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S1364661315002788>

11. Schofield P, Clarke A, Jones D, Martin D, McNamee P, Smith B. Chronic pain in later life: a review of current issues and challenges. *Aging health* [Internet]. 2011 Aug;7(4):551–6. Available from: <https://www.futuremedicine.com/doi/10.2217/ahe.11.41>

12. (NICE) NI for H and CE. Osteoarthritis. Care and management in adults [Internet]. 2014 [cited 2022 Jun 8]. Available from: www.nice.org.uk/guidance/cg177

13. Exercise and Acute Cardiovascular Events. *Med Sci Sport Exerc* [Internet]. 2007 May;39(5):886–97. Available from: <https://journals.lww.com/00005768-200705000-00020>

14. (SIGN) SIGN. Management of chronic pain [Internet]. SIGN publication no. 136. 2013 [cited 2022 Jun 8]. Available from: <https://www.sign.ac.uk/>

15. Stagg NJ, Mata HP, Ibrahim MM, Henriksen EJ, Porreca F, Vanderah TW, et al. Regular Exercise Reverses Sensory Hypersensitivity in a Rat Neuropathic Pain Model. *Anesthesiology* [Internet]. 2011 Apr 1;114(4):940–8. Available from: <https://pubs.asahq.org/anesthesiology/article/114/4/940/10465/Regular-Exercise-Reverses-Sensory-Hypersensitivity>
16. Mayer J, Mooney V, Dagenais S. Evidence-informed management of chronic low back pain with lumbar extensor strengthening exercises. *Spine J* [Internet]. 2008 Jan;8(1):96–113. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S1529943007008716>
17. Clifford C, Paul L, Syme G, Millar NL. Isometric versus isotonic exercise for greater trochanteric pain syndrome: a randomised controlled pilot study. *BMJ Open Sport Exerc Med* [Internet]. 2019 Sep 21;5(1):e000558. Available from: <https://bmjopensem.bmj.com/lookup/doi/10.1136/bmjsem-2019-000558>
18. Neumann DA. Extremidade inferior. In: *Cinesiologia do aparelho musculoesquelético - Fundamentos para a reabilitação*. 2^a. Elsevier; 2011. p. 465–519.
19. Figueroa C, Le PH. Anatomy, Bony Pelvis and Lower Limb, Pelvis Bones [Internet]. StatPearls. 2022. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/31424788>
20. Dalley KLMAF. Membro inferior. In: *Anatomia orientada para a clínica*. 5^a. Guanabara Koogan; 2007. p. 510–670.
21. PUTZ R. PR, editor. Sobotta, atlas de anatomia humana. 21^a. Rio de Janeiro: Guanabara Koogan; 2000.
22. Gold M, Munjal A, Varacallo M. Anatomy, Bony Pelvis and Lower Limb, Hip Joint [Internet]. StatPearls. 2022. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/29262200>

23. Chang A, Breeland G, Hubbard JB. Anatomy, Bony Pelvis and Lower Limb, Femur [Internet]. StatPearls. 2022. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/30422577>
24. Reid D. The management of greater trochanteric pain syndrome: A systematic literature review. *J Orthop* [Internet]. 2016 Mar;13(1):15–28. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S0972978X15001786>
25. Williams BS, Cohen SP. Greater trochanteric pain syndrome: A review of anatomy, diagnosis and treatment. *Anesth Analg*. 2009;108(5):1662–70.
26. Del Buono A, Papalia R, Khanduja V, Denaro V, Maffulli N. Management of the greater trochanteric pain syndrome: a systematic review. *Br Med Bull* [Internet]. 2012 Jun 1;102(1):115–31. Available from: <https://academic.oup.com/bmb/article-lookup/doi/10.1093/bmb/ldr038>
27. Grimaldi A, Mellor R, Hodges P, Bennell K, Wajswelner H, Vicenzino B. Gluteal Tendinopathy: A Review of Mechanisms, Assessment and Management. *Sport Med*. 2015;45(8):1107–19.
28. Ganderton C, Semciw A, Cook J, Pizzari T. Demystifying the Clinical Diagnosis of Greater Trochanteric Pain Syndrome in Women. *J Women's Heal* [Internet]. 2017 Jun;26(6):633–43. Available from: <http://www.liebertpub.com/doi/10.1089/jwh.2016.5889>
29. Ho GWK, Howard TM. Greater trochanteric pain syndrome: More than bursitis and iliotibial tract friction. *Curr Sports Med Rep*. 2012;11(5):232–8.
30. Reid D. The management of greater trochanteric pain syndrome: A systematic literature review. *J Orthop*. 2016;13(1):15–28.
31. Gazendam A, Ekhtiari S, Axelrod D, Gouveia K, Gyemi L, Ayeni O, et al. Comparative Efficacy of Nonoperative Treatments for Greater Trochanteric Pain

Syndrome. Clin J Sport Med [Internet]. 2021 Mar 12; Publish Ah. Available from: <https://journals.lww.com/10.1097/JSM.0000000000000924>

32. Barratt PA, Brookes N, Newson A. Conservative treatments for greater trochanteric pain syndrome: a systematic review. Br J Sports Med. 2017;51(2):97–104.

33. Fearon AM, Cook JL, Scarvell JM, Neeman T, Cormick W, Smith PN. Greater Trochanteric Pain Syndrome Negatively Affects Work, Physical Activity and Quality of Life: A Case Control Study. J Arthroplasty [Internet]. 2014 Feb;29(2):383–6. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S0883540313000752>

34. Birnbaum K, Siebert CH, Pandorf T, Schopphoff E, Prescher A, Niethard FU. Anatomical and biomechanical investigations of the iliotibial tract. Surg Radiol Anat [Internet]. 2004 Dec 18;26(6):433–46. Available from: <http://link.springer.com/10.1007/s00276-004-0265-8>

35. Antonio S, Wolfgang G, Robert H, Fullerton B, Carla S. The anatomical and functional relation between gluteus maximus and fascia lata. J Bodyw Mov Ther [Internet]. 2013 Oct;17(4):512–7. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S1360859213000648>

36. Stern JT. Anatomical and functional specializations of the human gluteus maximus. Am J Phys Anthropol [Internet]. 1972 May;36(3):315–39. Available from: <https://onlinelibrary.wiley.com/doi/10.1002/ajpa.1330360303>

37. Kummer B. Is the Pauwels' theory of hip biomechanics still valid? A critical analysis, based on modern methods. Ann Anat - Anat Anzeiger [Internet]. 1993 Jun;175(3):203–10. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S0940960211800026>

38. Sutter R, Kalberer F, Binkert CA, Graf N, Pfirrmann CWA, Gutzeit A. Abductor tendon tears are associated with hypertrophy of the tensor fasciae latae muscle.

Skeletal Radiol [Internet]. 2013 May 1;42(5):627–33. Available from: <http://link.springer.com/10.1007/s00256-012-1514-2>

39. Viradia NK, Berger AA, Dahners LE. Relationship between width of greater trochanters and width of iliac wings in trochanteric bursitis. *Am J Orthop* (Belle Mead NJ) [Internet]. 2011 Sep;40(9):E159-62. Available from: <http://www.ncbi.nlm.nih.gov/pubmed/22022680>

40. LeCocq E. Peritrochanteric bursitis: report of case. *J Bone Jt Surg.*1931;13(4):872–3.

41. Leonard MH. TROCHANTERIC SYNDROME. *J Am Med Assoc* [Internet]. 1958 Sep 13;168(2):175. Available from: <http://jama.jamanetwork.com/article.aspx?doi=10.1001/jama.1958.63000020003007a>

42. Collée G, Dijkmans BAC, Vandenbroucke JP, Cats A. Greater Trochanteric Pain Syndrome (Trochanteric Bursitis) in Low Back Pain. *Scand J Rheumatol* [Internet]. 1991 Jan 12;20(4):262–6. Available from: <http://www.tandfonline.com/doi/full/10.3109/03009749109096798>

43. Rompe JD, Segal NA, Cacchio A, Furia JP, Morral A, Maffulli N. Home Training, Local Corticosteroid Injection, or Radial Shock Wave Therapy for Greater Trochanter Pain Syndrome. *Am J Sports Med.* 2009;37(10):1981–90.

44. Cohen SP, Strassels SA, Foster L, Marvel J, Williams K, Crooks M, et al. Comparison of fluoroscopically guided and blind corticosteroid injections for greater trochanteric pain syndrome: multicentre randomised controlled trial. *BMJ* [Internet]. 2009 Apr 14;338(apr14 1):b1088–b1088. Available from: <https://www.bmj.com/lookup/doi/10.1136/bmj.b1088>

45. Brinks A, van Rijn RM, Willemsen SP, Bohnen AM, Verhaar JAN, Koes BW, et al. Corticosteroid Injections for Greater Trochanteric Pain Syndrome: A

Randomized Controlled Trial in Primary Care. *Ann Fam Med* [Internet]. 2011 May 1;9(3):226–34. Available from: <http://www.annfammed.org/cgi/doi/10.1370/afm.1232>

46. Ferrari R. A Cohort-Controlled Trial of Customized Foot Orthotics in Trochanteric Bursitis. *JPO J Prosthetics Orthot* [Internet]. 2012 Jul;24(3):107–10. Available from: <https://journals.lww.com/00008526-201207000-00003>

47. Altman DG. The Revised CONSORT Statement for Reporting Randomized Trials: Explanation and Elaboration. *Ann Intern Med* [Internet]. 2001 Apr 17;134(8):663. Available from: <http://annals.org/article.aspx?doi=10.7326/0003-4819-134-8-200104170-00012>

48. Mellor R, Bennell K, Grimaldi A, Nicolson P, Kasza J, Hodges P, et al. Education plus exercise versus corticosteroid injection use versus a wait and see approach on global outcome and pain from gluteal tendinopathy: Prospective, single blinded, randomised clinical trial. *Br J Sports Med*. 2018;52(22):1464–72.

49. Ganderton C, Semciw A, Cook J, Moreira E, Pizzari T. Gluteal Loading Versus Sham Exercises to Improve Pain and Dysfunction in Postmenopausal Women with Greater Trochanteric Pain Syndrome: A Randomized Controlled Trial. *J Women's Heal* [Internet]. 2018 Jun;27(6):815–29. Available from: <http://www.liebertpub.com/doi/10.1089/jwh.2017.6729>

ARTIGO 1

STUDY PROTOCOL

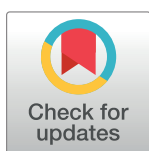
Motor control exercises versus general exercises for greater trochanteric pain syndrome: A protocol of a randomized controlled trial

Guilherme Thomaz de Aquino Nava¹✉*, Caroline Baldini Prudencio²✉, Rafael Krasic Alaiti³✉, Beatriz Mendes Tozim⁴✉, Rebecca Mellor⁵✉, Cristiane Rodrigues Pedroni^{1,4}✉, Angélica Mércia Pascon Barbosa^{2,4}✉, Marcelo Tavella Navega^{1,4}✉

1 Department of Physical Education, Institute of Biosciences, São Paulo State University (UNESP), Rio Claro, São Paulo, Brazil, **2** Department of Gynecology and Obstetrics, Botucatu Medical School, São Paulo State University (UNESP), Botucatu, São Paulo, Brazil, **3** Nucleus of Neuroscience and Behavior and Nucleus of Applied Neuroscience, Universidade de São Paulo (USP), São Paulo, Brazil, **4** Department of Physiotherapy and Occupational Therapy, Faculty of Philosophy and Sciences, São Paulo State University (UNESP), Marília, São Paulo, Brazil, **5** School of Health and Rehabilitation Sciences, The University of Queensland, Brisbane, Queensland, Australia

✉ These authors contributed equally to this work.

* gtanava@gmail.com



OPEN ACCESS

Citation: Thomaz de Aquino Nava G, Baldini Prudencio C, Krasic Alaiti R, Mendes Tozim B, Mellor R, Rodrigues Pedroni C, et al. (2022) Motor control exercises versus general exercises for greater trochanteric pain syndrome: A protocol of a randomized controlled trial. PLoS ONE 17(6): e0269230. <https://doi.org/10.1371/journal.pone.0269230>

Editor: George Vousden, Public Library of Science, UNITED KINGDOM

Received: July 19, 2021

Accepted: May 12, 2022

Published: June 24, 2022

Peer Review History: PLOS recognizes the benefits of transparency in the peer review process; therefore, we enable the publication of all of the content of peer review and author responses alongside final, published articles. The editorial history of this article is available here: <https://doi.org/10.1371/journal.pone.0269230>

Copyright: © 2022 Thomaz de Aquino Nava et al. This is an open access article distributed under the terms of the [Creative Commons Attribution License](https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Abstract

Introduction

Greater trochanteric pain syndrome is an overarching term used to define pain and tenderness in the greater trochanteric region of the femur, which is more common in women. Abnormal control of lower limb movements and deficient neuromuscular parameters may lead to greater trochanteric pain syndrome; however, no studies have used neuromuscular training as a treatment strategy. Thus, this study aims to compare the effect of a protocol of general exercises versus a program of motor control training on pain at baseline and after treatment in women with greater trochanteric pain syndrome.

Methods

The study was approved by the Research Ethics Committee (CAAE: 87372318.1.0000.5406) and has been prospectively registered on the Brazilian Registry of Clinical Trials (RBR-37gw2x). Sixty participants will be randomized to receive motor control exercises or general exercises. The application will be performed twice a week for 8 weeks. The participants will be evaluated before the treatment (T0), after 8 weeks of intervention (T8) and after 60 weeks of intervention (T60). The primary outcome measures will be the hip pain intensity, and secondary outcomes will be muscle strength, kinesiophobia, global perceived effect, pain catastrophization, central sensitization and quality of life.

Data Availability Statement: Research data will be made publicly available when the study is completed and published.

Funding: GTAN (Finance Code 001): Coordenação de Aperfeiçoamento de Pessoal de Nível Superior, Brasil (CAPES) - Doctorate's degree scholarship. <https://www.gov.br/capes/pt-br> The funders had and will not have a role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Competing interests: The authors have declared that no competing interests exist.

Conclusions

Studies have suggested that greater trochanteric pain syndrome may be related to poor hip and pelvic control, however, no study has investigated an exercise protocol focused on increasing the strength of the abductor and extensor muscles of the hip associated with pelvic control training, especially in positions of unilateral support, such as gait. This study will help determine whether greater trochanteric pain syndrome is related to abnormal control of lower limb movements.

Background

Greater trochanteric pain syndrome (GTPS) is an overarching term used to define pain and tenderness in the greater trochanteric region of the femur [1, 2]. It is estimated that 10 to 25% of the population will develop some type of pain in the lateral hip region [1–3], predominantly in women over 40 years old [2–6]. GTPS directly impacts the worsening quality of life, which is similar to the findings in individuals with severe hip osteoarthritis [7]. Women present pathomechanisms that can influence the onset of the GTPS, such as, smaller gluteal tendinous insertions on the femur, shorter gluteal moment arm and weakness of the gluteus medius [6].

Changes in muscle function of the gluteus medius and minimus muscles may lead to poor hip and pelvic control, and leading to increased hip adduction in the frontal plane, especially in positions of unilateral support, such as single leg standing [6, 8]. Physical exercise are preferable to passive approaches in the treatment of GTPS as they result in better short-term [9, 10], medium [9] and long-term [9–11] outcomes in terms of pain and function when compared to rest, shock-wave therapy and / or invasive treatments, e.g. corticosteroid injection (CSI) [5, 9, 11].

Individuals with GTPS have abnormal control of lower limb movements and deficient neuromuscular parameters [8, 12, 13] and alterations in trunk and pelvic kinematics during walking [14], however, no studies have used neuromuscular training as a treatment strategy and there is insufficient evidence about the influence of this intervention in terms of the clinical and biomechanical aspects. Thus, this study aims to compare the effect of a protocol of general exercises versus a program of motor control training on pain at baseline and after treatment, at 8 and 60 weeks in women with GTPS. We hypothesize that both the women undergoing the motor control protocol and the women undergoing the general exercise group (GEG) will show improvements in all evaluated outcomes, although the motor control group (MCG) will be superior due to the intervention being specific to the hip region.

Material and methods

Design

A two-arm, parallel randomized, double-blinded (outcome assessor and statistician), will be performed. All personal data will be confidential. The study follows the TIDieR (Template for Intervention Description and Replication) checklist [15] and the 2013 Standard Protocol Items: Recommendations for International Trials statement [16] (Fig 1).

Ethical aspects

The study was approved by the Research Ethics Committee of the São Paulo State University of the Faculty of Philosophy and Sciences / Campus of Marília (CAAE: 87372318.1.0000.5406), first approval was in April, 20th 2018.

TIMEPOINT	STUDY PERIOD			
	Screening	Baseline	Post-allocation	
	-t ₁	0	Week 8	Week 60
ENROLMENT:				
Eligibility screen	X			
Informed consent	X			
Allocation		X		
INTERVENTIONS:				
<i>Motor control exercises</i>				
<i>General exercises</i>				
ASSESSMENTS:				
<i>Pain</i>		X	X	X
<i>Global perceived effect</i>			X	X
<i>Muscle strength</i>		X	X	
<i>Pain catastrophization</i>		X	X	X
<i>Kinesiophobia</i>		X	X	X
<i>Central sensitization</i>		X	X	X
<i>Quality of life</i>		X	X	X

Fig 1. Schedule of the study protocol according to the standard protocol items: Recommendations for interventional trials checklist.

<https://doi.org/10.1371/journal.pone.0269230.g001>

The protocol of this study has been prospectively registered on the Brazilian Registry of Clinical Trials (RBR-37gw2x). Participants will be informed about all study procedures and asked to sign the Informed Consent Form prior to their enrollment in the study.

Participants

Recruitment. Women with GTPS will be recruited in the community, universities and within the public health service, through digital (facebook and instagram) and written dissemination (flyers) placed in the public health service and at the universities. Interested participants will contact the main researcher via phone or social media.

Eligibility criteria

Inclusion and exclusion criteria. Initial screening will be made by telephone. Potential participants will be eligible for the study if they are between 18 and 70 years old, do only recreational physical activity less than twice a week, and have had lateral hip pain for ≥ 3 months. They should have been feeling pain during one or more of these seven daily activities: walking, prolonged standing, standing up from the seated position, prolonged sitting, climbing stairs, climbing up hills or slopes, and side-lying. Potential participants will be ineligible for the study

if they have a body mass index (BMI) $> 36\text{kg} / \text{m}^2$, have received some type of invasive intervention for lateral hip pain (e.g. CSI) or physical therapy intervention for their hip pain in the last 12 weeks, have morning stiffness in the hip ≤ 60 minutes, any disease affecting the neuromuscular system or that may prevent data collection, have had spinal or hip surgery, any infectious condition, any neoplasm or cannot commit to participating for the duration of treatment [10, 11, 14, 17, 18].

Procedures

Potential participants who fulfil the eligibility criteria by phone will then undergo two assessments. The first one will be a clinical screening and will be carried out to screen the inclusion and exclusion criteria that were not possible to evaluate by phone, as well as describing in more detail the nature of the study and commitment required, with the opportunity for the potential participant to ask questions. The clinical screening will be carried out at São Paulo State University and will take approximately 40 minutes to 1 hour. A registered physiotherapist with 8 years of experience, and who has a Master in musculoskeletal disorders will make the evaluation. Anthropometric data (age, weight, height, and BMI), personal information (name, address, telephone number), demographic partner (profession, race and education) and pathological and clinical history will be collected. The personal data of the participants will be numerically coded and stored in a database. It will be determined whether the participants have the ability to manipulate shoes and socks [19], have limitation in the range of motion of spine, hip or lower limb that affects gait or the data collection or visible lower limb discrepancy. It will be assessed whether the participants have palpation tenderness over the greater trochanteric region of the femur [8, 20, 21]. If both hips are symptomatic, the most painful side will be evaluated [10]. Trendelenburg sign, which is the pelvic drop during single leg stance, indicating inefficiency of hip abductor muscles, will be evaluated [5, 8, 20].

The tests that will be used for clinical evaluation are intended to define the exact location of the pain and to transmit compressive and/or tensile forces on the tendons of the abductor gluteal muscles over the greater trochanter. The presence of pain on palpation is an inclusion criteria, therefore, it is mandatory for participation in the study.

- Palpation of the greater trochanter: positive palpation tenderness, considered when there is pain over the greater trochanter of the femur, during the evaluation in lateral decubitus (LD) with the pain side up, flexion of the hip joint and knees together [5, 6, 8, 11, 18].

Because of the little benefit of the greater trochanteric palpation when the test is positive, due to the poor specificity, another test with high specificity will be used to rule in the greater trochanteric pain syndrome, to reduce false positive. Additionally to the positive greater trochanteric palpation test, the participants also must experience pain in one or more of the six provocative clinical pain tests [13, 17, 18]. They are:

- Hip FADER: Participant in supine position (SP), has to report pain over the greater trochanter when the affected lower limb is positioned in 90° flexion, adduction and external hip rotation [18].
- Hip FADER-R with static muscle test: Participant in SP, has to report pain when the affected lower limb is positioned in the same way but maintaining isometric resistance to internal rotation at the end of range of motion [5, 6, 8, 11, 18].
- Patrick-Faber test: Participant in SP, has to report pain when the affected lower limb is positioned in flexion, abduction and external hip rotation [6, 18, 19].

- ADD: Participant has to report pain when the affected lower limb is positioned in passive hip adduction in LD [18].
- ADD R: Participant has to report pain when the affected lower limb is positioned in passive hip adduction in LD but maintaining isometric resistance to abduction [18].
- Single leg stance (SLS): Participant has to report pain while standing on one leg for 30 seconds [6].

The second assessment will be carried out by two different blinded assessors, both registered physiotherapists with PhD in musculoskeletal disorders, to evaluate the participants outcomes. They are pain intensity, global perceived effect, muscle strength, pain catastrophization, kinesiophobia, central sensitization and quality of life. The blinded assessors will evaluate the participants at baseline (before the treatment), after 8 weeks of intervention and after 60 weeks of intervention.

Research team

The trial will involve five researchers; two researcher responsible for evaluations; one researcher responsible for interventions; one researcher responsible for randomising participants and one researcher who will perform the statistical analysis.

Sample size and power analysis

The sample size calculation was performed through the G * Power software and was based on the ability to detect a difference of 2 points (pilot standard deviation of $\pm 0,8$ points) of pain intensity score, because it is the primary outcome of the research. A power of 0.80, probability of error α 0.05, effect size of 0,48 and a 15% dropout rate were used, thus we will recruit 60 participants (30 in each group) [9].

Evaluations

The participants will be evaluated before the treatment (T0), after 8 weeks of intervention (T8) and after 60 weeks of intervention (T60).

Randomization, allocation and blinding

If all eligibility criteria are fulfilled, and if the presence of GTPS is determined, the participants will be randomly assigned to receive either 1) motor control exercises or 2) general exercises (Fig 2). At this point, before the blind evaluation, participants will give their free and informed consent.

Participants will be randomly allocated to two therapeutic arms using permuted, block-randomization to balance the number of participants allocated to each group. The permuted block (with six participants per block) randomization sequence will be generated by the website www.sealedenvelope.com. The participants will be informed of their random allocation by one of the researchers not involved with the assessment process. After the randomization, the participants will be invited to return for physiotherapeutic evaluation (T0), with blinded assessors both registered physiotherapists with PhD in musculoskeletal disorders, to evaluate the participants outcomes. These assessors will not participate in the screening or interventions. All participants will be advised not to disclose to the assessor any details about the intervention program that they have received (to ensure that allocation is concealed from the assessor).

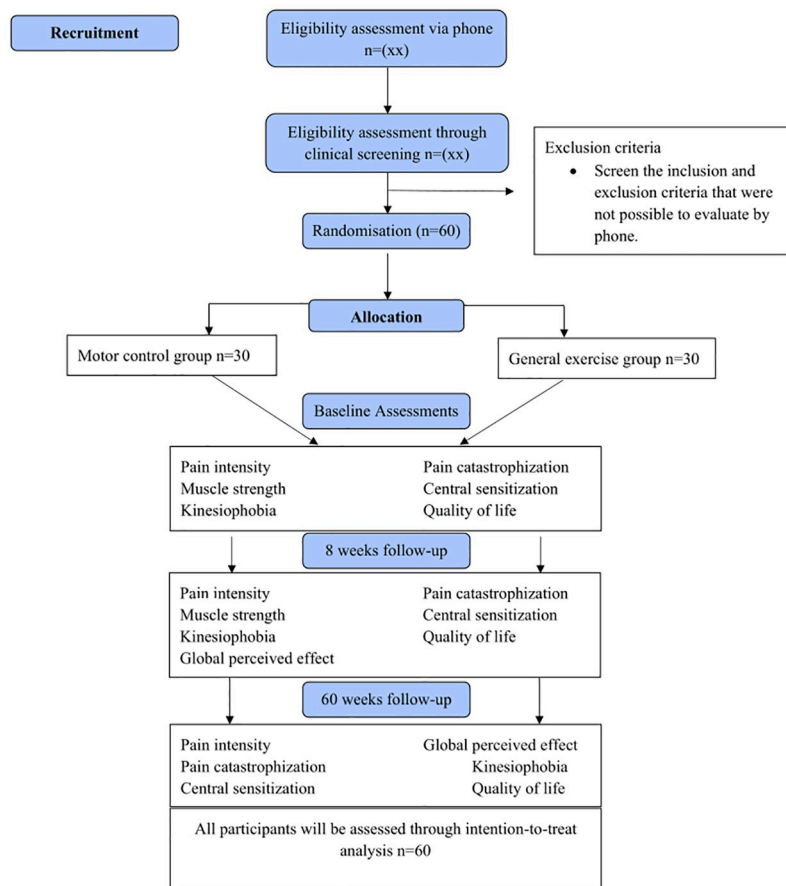


Fig 2. Study fluxogram.

<https://doi.org/10.1371/journal.pone.0269230.g002>

Outcome measures

Primary outcome measure. There is one primary outcomes measure: 1) Average pain over the previous week.

1) Pain intensity will be assessed at baseline (T0) and after treatment at 8 weeks (T8). It will also be assessed at 60 weeks (T60), which is a secondary time point for the primary outcome. Pain intensity will be assessed by the visual analog scale (VAS) [5]. Formed by a horizontal line of 100 mm, anchored by the words “no pain / discomfort” and “worst pain / discomfort imaginable” [5]. To measure the pain, the participant will be asked to indicate the level pain they are experiencing at the present moment and the average pain they experienced in the last week by marking the scale with a line. A ruler will be used to measure the value obtained [5].

Secondary outcomes measures. There are five secondary outcomes measures: 1) Global perceived effect, 2) Muscle strength, 3) Pain catastrophization, 4) Kinesiophobia, 5) Central sensitization and 6) Quality of life.

1. The scale of global perceived effect (GPE) will be used after treatment, at 8 (T8) and 60 weeks (T60) during post-intervention reassessment [22]. This is a 7-point scale (1 = completely recovered, 7 = worse than ever) to assess recovery. GPE evaluates the participant’s perception regarding the modification of their clinical condition after the intervention, and is assessed by a simple and easily understood question with alternative answer options which will be dichotomized into “improved” (“completely recovered” and “much



Fig 3. Hip abductor muscles evaluation.

<https://doi.org/10.1371/journal.pone.0269230.g003>

improved”) versus “not improved” (“slightly improved,” “not changed,” “slightly worsened,” “much worsened,” “worse than ever” [22].

2. The isometric strength of the hip abductor and extensor muscles will be assessed at baseline (T0) and after treatment, at 8 weeks (T8) during post-intervention reassessment. A Lafayette Manual Muscle Tester (Lafayette Instruments) will be used, which has been shown to be a valid method of assessing isolated muscle contraction strength [23]. To evaluate the hip abductor muscles, the participants will be positioned supine on a stretcher, stabilized by velcro bands around the pelvis and above the lateral ankle malleolus to avoid compensatory movements and the influence of the examiner’s resistance [23]. The hand dynamometer will be positioned above the lateral ankle malleolus and fixed to the stretcher by an inelastic band, it will be positioned without rotation, with 10° of hip abduction to minimize the compression potential of the tendons against the greater trochanter [13]. The untested lower limb will be positioned with 45° of hip and knee flexion, with the foot positioned on the stretcher and the upper limbs resting at the side of the body (Fig 3) [13].

To evaluate the hip extensors, the participants will be positioned in the prone position (PP) with knee flexion in the lower limb to be evaluated. The hand dynamometer will be positioned on the posterior thigh, above the popliteal fossa and will be stabilized by an inelastic velcro band [24]. Another Velcro band will be positioned around the pelvis (Fig 4) [24]. Measurement of limb lengths will be taken with a standard cloth tape measure in order to calculate torque, from the greater trochanter to the center of the dynamometer, and will be recorded in meters [24, 25]. The tests of maximal isometric strength will be performed 3



Fig 4. Hip extensor muscles evaluation.

<https://doi.org/10.1371/journal.pone.0269230.g004>

times with 5 seconds duration for each contraction, with 30 seconds of rest between each attempt [24]. Participants will be verbally encouraged to perform as much force as possible during the test. Strength values will be normalized by the weight of each participant [24].

3. Pain catastrophization will be measured with the Pain Catastrophizing Scale (PCS) at baseline (T0) and after treatment, at 8 (T8) and 60 weeks (T60) during post-intervention reassessment. PCS is a validated [26], self-administered, 13-item questionnaire that assesses catastrophic thoughts, feelings, and behavior when in pain [26]. This questionnaire assesses three major domains: helplessness, magnification and rumination in relation to pain. Results are calculated by summing all survey items and total scores range from 0 to 52, with higher scores indicating higher levels of pain catastrophization [26].
4. Kinesiophobia will be assessed with the Tampa Scale for Kinesiophobia (TSK), which is a validated, 17 question, self-administered questionnaire which has been translated into Portuguese. Kinesiophobia will be assessed at baseline (T0) and after treatment, at 8 (T8) and 60 weeks (T60) during post-intervention reassessment. The final score can be at least 17 and at most 68 points, with higher scores indicating higher degrees of kinesiophobia [27].
5. Central sensitization will be measured with the central sensitization inventory, which is a self-reported health symptoms questionnaire designed as an easy-to-administer tracker for patients who are at high risk for central sensitization, or for assessing symptoms related to central sensitization [28]. Central sensitization will be measured at baseline (T0) and after treatment, at 8 (T8) and 60 weeks (T60) during post-intervention reassessment. It has also been recommended as a component of an algorithm to help classify chronic pain patients with central sensitization and to help differentiate them from patients with primary neuropathic and nociceptive pain [28].
6. The quality of life will be assessed using the International Hip Outcome Tool (iHOT) which is a 12-question self-administered questionnaire. The questions are evaluated using a visual analogue scale, so each question has a 10 cm line and the participants must add a vertical line crossing the horizontal line, and the farther to the left, the worse the symptoms. The result of each question can vary between 0 and 100 and to determine the result, all the questions must be added and divided by the number of answered questions [29]. The quality of life will be measured at baseline (T0) and after treatment, at 8 (T8) and 60 weeks (T60) during post-intervention reassessment.

Interventions

Motor control group. The motor control program will be performed over 8 weeks, with two weekly appointments, face-to-face and individualized. There will be a total of 16 appointments, each lasting 50–60 minutes. The protocol will consist of isotonic and isometric strengthening exercises, focused on abductor and extensor muscles of the hip with coordination through verbal commands to improve the dynamic motor control of the lower limbs. Exercise progression will occur through elastic bands (Domyos), from the easiest to the most difficult, and the addition of more difficult exercises [24]. In the first week there will be no use of load, however from the second week the MCG will be tested with three different colors of elastic resistance bands (green = easy, blue = medium and orange = hard), from the easiest to the hardest and will be instructed to perform 3–5 repetitions with each band [24]. They will decide which elastic band they feel they would be able to perform 3 sets with 8–12 repetitions, maintaining the quality of movement [24]. Participants will choose the color of elastic band

for each exercise and the elastic band will be positioned above the knee joint. The load progression test will be performed weekly and the load progression will be increased according to the modified Borg scale (0–10), when 3 (moderate) or lower scores (easy) are reached, the load progression will be made to the subsequent elastic band [24]. They will also use an aerobic step in the last two weeks. The rest between exercises will be one minute [30]. As for the evolution of the exercises, if the participants are unable to progress due to pain enough to give up the exercise, or difficulty in performing at least 8 repetitions with quality, they will remain with the parameters they were able to perform (Table 1).

Table 1. Exercise dosage and progressions of motor control protocol.

Weeks	Exercise	Sets	Reps	Position	Material
1 st and 2 nd	Bilateral bridge	3	Hold 15s	Supine	Elastic band
			8–12		
	Bridge with feet together	3	Hold 15s	Supine	Elastic band
			8–12		
	Clamshell	3	Hold 15s	Lateral decubitus	Elastic band
			8–12		
	Hip abduction with lower limbs flexed	3	Hold 15s	Lateral decubitus	Elastic band
			8–12		
	Double leg squat	3	Hold 15s	Standing	Elastic band
			8–12		
3 rd and 4 th	Single leg bridge	3	Hold 15s	Supine	Elastic band
			8–12		
	Hip abduction with lower limbs extended	3	Hold 15s	Lateral decubitus	Elastic band
			8–12		
	Hip and knee extension	3	Hold 15s	Four-point	Elastic band
			8–12		
	Hip abduction	3	Hold 15s	Standing	Elastic band
			8–12		
	Double leg squat	3	Hold 15s	Standing	Elastic band
			8–12		
5 th and 6 th	Single leg bridge with hip abduction	3	8–12	Supine	Elastic band
	Hip abduction, flexion and extension	3	8–12	Lateral decubitus	Elastic band
	Hip abduction	3	Hold 15s	Four-point	Elastic band
	Hip abduction and extension	3	8–12	Four-point	Elastic band
	Side walking	3	8–12	Standing	Elastic band
	Reverse lunge	3	8–12	Standing	Elastic band
	Single leg stance	3	Hold 15s	Standing	Elastic band
	Single leg stance and squat	3	8–12	Standing	Elastic band
7 th and 8 th	Side walking	3	8–12	Standing	Elastic band
	Side walking with squat	3	8–12	Standing	Elastic band
	Single leg stance with trunk rotation	3	8–12	Standing	Elastic band
	Single leg stance with flexion and extension of the contralateral hip	3	8–12	Standing	Elastic band
	Single leg stance with flexion, abduction and extension of the hip	3	8–12	Standing	Elastic band
	Hip Hike	3	Hold 15s	Standing	Elastic band Step
			8–12		
	Walk	3	8–12	Standing	Elastic band

Reps: Repetitions; s: Seconds

<https://doi.org/10.1371/journal.pone.0269230.t001>

General exercise group. The general exercise program will be performed over 8 weeks, with two weekly appointments, face-to-face and individualized. There will be a total of 16 appointments, each lasting 50–60 minutes. The protocol will consist of 5 minutes walking warm-up, stretching and strengthening of the muscle groups of the lower trunk, hip and lower limbs. Exercise progression will occur through elastic bands (Domyos), from the easiest to the most difficult (green = easy, blue = medium and orange = hard), with the use of an exercise ball and the addition of more difficult exercises [24]. In the first week there will be no use of load, however from the second week the GEG will be tested with three different colors of elastic resistance band, from the easiest to the hardest and instructed to perform 3–5 repetitions with each band [24]. They will decide which elastic band they feel they would be able to perform 3 sets with 8–12 repetitions, whilst maintaining the quality of movement [24]. Participants will choose the color of elastic band for each exercise, and the elastic band will be positioned above the knee joint. The load progression test will be performed weekly and the load progression will be increased according to the modified Borg scale (0–10), when 3 (moderate) or lower scores (easy) are reached, the load progression will be made to the subsequent elastic band [24]. The rest between exercises will be one minute [30]. As for the evolution of the exercises, if the participants are unable to progress due to pain enough to give up the exercise, or difficulty in performing at least 8 repetitions with quality, they will remain with the parameters they were able to perform (Table 2).

Statistical analysis

The study will be run as a superiority trial. The statistical analysis will follow the intention-to-treat concept. Statistical analysis will be performed using the software IBM SPSS Statistics for Windows, version 20.0 (IBM Corp., Armonk, N.Y., USA) and statistician will be blind. Data will be evaluated using exploratory statistical techniques. Firstly, the normality and homogeneity of the data will be verified and then the appropriate statistical analyses will be adopted for the variables. The between-group differences for the primary and secondary outcomes and their respective confidence intervals at 95% will be calculated by constructing mixed linear models. “Time” and “group” will be considered fixed effects, whereas the participants will be considered the random effect. The time by group interaction will be included in the analysis to assess the difference effect between the groups at each follow-up, and the dependent variable baseline value will be included as a covariate for the correction of possible differences [31]. The significance level will be 0.05 for all statistical analyses.

A causal mediation analysis will be conducted using the “mediate” package in R (The R Foundation for Statistical Computing). A model-based inference approach will be used to estimate the average causal mediation effect (ACME), average direct effect (ADE) and the average total effect for pain [32]. Two regression models will be created to each outcome: the mediator model and the outcome model. If there is no total effect, we will conduct several univariate mediation models to verify where the causal pathway braked down. By the other hand, if there is a between-group difference, we will construct a multivariate mediation model to verify how the intervention works through the putative mediators.

The mediator model will be constructed with treatment allocation as the independent variable and the putative mediator as the dependent variable. The outcome model will be constructed with the treatment allocation and the putative mediator as independent variables and the outcome as independent variable. The outcome models were adjusted for potential confounders (i.e. age, sex). Continuous mediators and outcomes normally distributed will be modelled using linear models (*lm*).

Table 2. Exercise dosage and progression of general exercises.

Weeks	Exercises	Sets	Reps	Position	Material
1 st and 2 nd	Warm up walk	1	5 minutes		
	Unilateral hamstring stretch	1	Hold 60s	Supine	
	Bilateral hamstring stretch	1	Hold 60s	Supine	
	Hip external rotation mobility	3	8–12	Supine	
	Hip internal rotation mobility	3	8–12	Supine	
	Hip flexors strengthening with flexed lower limbs	3	8–12	Supine	Elastic band
	Hip adductors strengthening with knees flexed	3	8–12	Supine	Ball
	Hip extensors strengthening with knees flexed	3	8–12	Prone	Elastic band
	Knee extensors stretching	1	Hold 60s	Prone	
	Hip adductors stretching	1	Hold 60s	Sitting down	
3 rd and 4 th	Warm up walk	1	5 minutes		
	Piriformis stretching	1	Hold 60s	Supine	
	Abductor stretching	1	Hold 60s	Supine	
	Hip flexors strengthening with one leg straight moving up and down	3	8–12	Supine	Elastic band
	Hip extensors strengthening with the lower limbs extended	3	8–12	Prone	Elastic band
	Hip adductors strengthening with knees flexed	3	8–12	Supine	Ball
	Hip abductors strengthening with knees flexed	3	8–12	Supine	Elastic band
	Hip adductors stretching	1	Hold 60s	Sitting	
	Hip flexors stretching	1	Hold 60s	Semi-sitting	
	Knee extensors stretching	1	Hold 60s	Standing	
5 th and 6 th	Warm up walk	1	5 minutes		
	Trunk flexor stretching with elbows supported	1	Hold 60s	Prone	
	Hip flexors strengthening with trunk elevated	3	8–12	Supine	Elastic band
	Adductor muscles stretching	1	Hold 60s	Sitting down	
	Trunk extensor stretching	1	Hold 60s	Sitting down	
	Sitting on the feet, stretching the body forward	1	Hold 60s		
	Trunk lateral stretching	1	Hold 60s	Sitting down	
	Hip adductors strengthening	3	8–12	Standing	
	Squats against wall	3	8–12	Standing	Ball
	Hip abductor strengthening	3	8–12	Standing	Elastic band
7 th and 8 th	Knee extensors stretching	1	Hold 60s	Standing	
	Warm up walk	1	5 minutes		
	Trunk flexor stretching with upper limbs straight	1	Hold 60s	Prone	
	Trunk and hip extensors strengthening elevating upper and lower limbs	3	8–12	Prone	
	Trunk rotation stretching	1	Hold 60s	Sitting down	
	Trunk strengthening by flexing arm and contralateral leg.	3	8–12	four-point stance	Elastic band
	Sitting on the feet, stretching the body forward	1	Hold 60s		
	Hamstring strengthening	3	8–12	Standing	Elastic band
	Hip flexors strengthening	3	8–12	Standing	Elastic band
	Hip extensors strengthening	3	8–12	Standing	Elastic band
	Iliotibial band stretching	1	Hold 60s	Standing	

Reps: Repetitions; s: Seconds

<https://doi.org/10.1371/journal.pone.0269230.t002>

The *mediate* function will be used to estimate the value of the mediator and outcome. The simulated potential values of the mediator and outcome will be used to compute the ACME, ADE and average total effect. We will use 1000 bootstrap simulations to generate 95% confidence intervals (95% CI) if linear assumptions of mediator and/or outcome models are not violated. Non-parametric bootstrap simulations will be used if the linear assumptions of the mediator and/or outcome models are violated. The putative mediators that will be investigated in both models will be hip extensors and abductors muscle strength.

Discussion

This study aims to evaluate whether there will be a difference in pain intensity between individuals with GTPS who have undergone an exercise protocol with an emphasis on motor control training and those who have undergone a program of general, nonspecific exercises. Taking into consideration that no studies have used neuromuscular training as a treatment strategy for GTPS, and there is insufficient evidence about the influence of this intervention in terms of the clinical and biomechanical aspects, this study is necessary.

Exercises are considered to be the cornerstone of non-surgical treatment for chronic musculoskeletal pain [18]. We chose two types of protocols: the MCG was developed to be specific to the targeted muscle group, focusing not only on strengthening, but also on improving gait patterns, maintaining correct, efficient movement patterns, and providing guidance on how to avoid aggravating positions such as excessive adduction of the femur during functional activities. For GEG, a more general, non-specific exercise protocol will be applied, without advice on positioning or strategies to avoid aggravation of pain—only warm-up, stretching and non-specific strengthening exercises will be performed.

The diagnosis of GTPS is clinical and two studies by Grimaldi et al. 2017 and Ganderton et al. 2017 demonstrated that palpation over the greater trochanter has a sensitivity of 80% and 85.7% respectively, and a specificity of 47% and 61.1% respectively. They also reported likelihood ratios of 0.43 and 2.2, respectively, demonstrating that this test alone, when negative, is able to rule out the presence of GTPS [6, 20]. However, the combination of palpation and one other of the FABER, SLS, FADER, FADER-R, ADD, ADD-R tests increases the chances of detecting GTPS due to the specificity of these tests, which can reach 100%, for this reason, we will apply a combination of multiple clinical tests to avoid the inclusion of participants who do not have GTPS [5, 6, 18, 20].

The clinical trial will conform to the standards of the consort group [33]. Study participants will be randomized to participate in one of the groups through concealed allocation [18, 33]. It is not possible to blind the clinician or the participant to group allocation. Only the assessor of the outcome measures and the statistician are able to be blinded to treatment allocation. The importance of not disclosing anything to this assessor about the nature of their treatment will be strongly emphasized to participants. The statistical analysis will be conducted blind to treatment group allocation—the actual groups will only be revealed post analysis. In addition, intention-to-treat analysis will be used [34]. As a limitation of the study, we highlight the participation of women only, so care must be taken when extrapolating data to men with the same conditions.

The idea of the research arose due to studies that pointed out physical exercises as the first line of treatment for the management of tendinopathies [5, 17, 18]. General exercise has the ability to decrease nociceptive afferent input to the central nervous system (CNS) and thus decrease pain [10], however our motor control protocol consists, in addition to isotonic exercises, of isometric exercises that have been reported to target both peripheral and central pain drivers by releasing cortical inhibition and reducing tendon pain [35]. In addition, the MCG

consists of neuromuscular training, which may be the reason for this protocol to be superior to the GEG. The findings of this study will contribute to determining the effect on pain of both MCG and GEG in the management of individuals with GTPS. This information may be used by health professionals to assist them in clinical decision making and selecting the most appropriate training program for management of GTPS.

Trial status

Participants will be recruited and will receive treatment until 2022.

Supporting information

S1 Checklist. SPIRIT 2013 checklist: Recommended items to address in a clinical trial protocol and related documents*.

(PDF)

S1 Protocol.

(DOCX)

S2 Protocol.

(DOCX)

S3 Protocol.

(PDF)

Author Contributions

Conceptualization: Guilherme Thomaz de Aquino Nava, Caroline Baldini Prudencio, Rafael Krasic Alaiti, Beatriz Mendes Tozim, Cristiane Rodrigues Pedroni, Angélica Mércia Pascon Barbosa, Marcelo Tavella Navega.

Data curation: Guilherme Thomaz de Aquino Nava, Rafael Krasic Alaiti.

Formal analysis: Rafael Krasic Alaiti.

Funding acquisition: Guilherme Thomaz de Aquino Nava.

Investigation: Guilherme Thomaz de Aquino Nava, Caroline Baldini Prudencio, Beatriz Mendes Tozim, Rebecca Mellor, Cristiane Rodrigues Pedroni, Angélica Mércia Pascon Barbosa, Marcelo Tavella Navega.

Methodology: Guilherme Thomaz de Aquino Nava, Caroline Baldini Prudencio, Rafael Krasic Alaiti, Beatriz Mendes Tozim, Rebecca Mellor, Cristiane Rodrigues Pedroni, Angélica Mércia Pascon Barbosa, Marcelo Tavella Navega.

Project administration: Guilherme Thomaz de Aquino Nava, Marcelo Tavella Navega.

Software: Guilherme Thomaz de Aquino Nava, Caroline Baldini Prudencio, Beatriz Mendes Tozim, Cristiane Rodrigues Pedroni, Angélica Mércia Pascon Barbosa, Marcelo Tavella Navega.

Supervision: Guilherme Thomaz de Aquino Nava, Marcelo Tavella Navega.

Validation: Guilherme Thomaz de Aquino Nava, Caroline Baldini Prudencio, Rebecca Mellor, Cristiane Rodrigues Pedroni, Angélica Mércia Pascon Barbosa, Marcelo Tavella Navega.

Visualization: Guilherme Thomaz de Aquino Nava, Marcelo Tavella Navega.

Writing – original draft: Guilherme Thomaz de Aquino Nava, Caroline Baldini Prudencio, Rafael Krasic Alaiti, Beatriz Mendes Tozim, Rebecca Mellor, Cristiane Rodrigues Pedroni, Angélica Mércia Pascon Barbosa, Marcelo Tavella Navega.

Writing – review & editing: Guilherme Thomaz de Aquino Nava, Caroline Baldini Prudencio, Rafael Krasic Alaiti, Beatriz Mendes Tozim, Rebecca Mellor, Cristiane Rodrigues Pedroni, Angélica Mércia Pascon Barbosa, Marcelo Tavella Navega.

References

1. Ho GWK, Howard TM. Greater trochanteric pain syndrome: More than bursitis and iliotibial tract friction. *Curr Sports Med Rep*. 2012; 11: 232–238. <https://doi.org/10.1249/JSR.0b013e3182698f47> PMID: 22965345
2. Reid D. The management of greater trochanteric pain syndrome: A systematic literature review. *J Orthop*. 2016; 13: 15–28. <https://doi.org/10.1016/j.jor.2015.12.006> PMID: 26955229
3. Williams BS, Cohen SP. Greater trochanteric pain syndrome: A review of anatomy, diagnosis and treatment. *Anesth Analg*. 2009; 108: 1662–1670. <https://doi.org/10.1213/ane.0b013e31819d6562> PMID: 19372352
4. Grimaldi A, Mellor R, Hodges P, Bennell K, Wajswelner H, Vicenzino B. Gluteal Tendinopathy: A Review of Mechanisms, Assessment and Management. *Sport Med*. 2015; 45: 1107–1119. <https://doi.org/10.1007/s40279-015-0336-5> PMID: 25969366
5. Ganderton C, Semciw A, Cook J, Pizzari T. Does menopausal hormone therapy (MHT), exercise or a combination of both, improve pain and function in post-menopausal women with greater trochanteric pain syndrome (GTPS)? A randomised controlled trial. *BMC Womens Health*. 2016; 16: 32. <https://doi.org/10.1186/s12905-016-0311-9> PMID: 27312538
6. Ganderton C, Semciw A, Cook J, Pizzari T. Demystifying the Clinical Diagnosis of Greater Trochanteric Pain Syndrome in Women. *J Women's Heal*. 2017; 26: 633–643. <https://doi.org/10.1089/jwh.2016.5889> PMID: 28263673
7. Fearon AM, Cook JL, Scarvell JM, Neeman T, Cormick W, Smith PN. Greater Trochanteric Pain Syndrome Negatively Affects Work, Physical Activity and Quality of Life: A Case Control Study. *J Arthroplasty*. 2014; 29: 383–386. <https://doi.org/10.1016/j.arth.2012.10.016> PMID: 24210307
8. Ganderton C, Pizzari T, Harle T, Cook J, Semciw A. A comparison of gluteus medius, gluteus minimus and tensor fascia latae muscle activation during gait in post-menopausal women with and without greater trochanteric pain syndrome. *J Electromyogr Kinesiol*. 2017; 33: 39–47. <https://doi.org/10.1016/j.jelekin.2017.01.004> PMID: 28171786
9. Mellor R, Bennell K, Grimaldi A, Nicolson P, Kasza J, Hodges P, et al. Education plus exercise versus corticosteroid injection use versus a wait and see approach on global outcome and pain from gluteal tendinopathy: Prospective, single blinded, randomised clinical trial. *Br J Sports Med*. 2018; 52: 1464–1472. <https://doi.org/10.1136/bjsports-2018-k1662rep> PMID: 30385462
10. Ganderton C, Semciw A, Cook J, Moreira E, Pizzari T. Gluteal Loading Versus Sham Exercises to Improve Pain and Dysfunction in Postmenopausal Women with Greater Trochanteric Pain Syndrome: A Randomized Controlled Trial. *J Women's Heal*. 2018; 27: 815–829. <https://doi.org/10.1089/jwh.2017.6729> PMID: 29715073
11. Rompe JD, Segal NA, Cacchio A, Furia JP, Morral A, Maffulli N. Home Training, Local Corticosteroid Injection, or Radial Shock Wave Therapy for Greater Trochanter Pain Syndrome. *Am J Sports Med*. 2009; 37: 1981–1990. <https://doi.org/10.1177/0363546509334374> PMID: 19439758
12. Allison K, Salomoni SE, Bennell KL, Wrigley T V., Hug F, Vicenzino B, et al. Hip abductor muscle activity during walking in individuals with gluteal tendinopathy. *Scand J Med Sci Sports*. 2018; 28: 686–695. <https://doi.org/10.1111/sms.12942> PMID: 28675778
13. Allison K, Vicenzino B, Wrigley T V., Grimaldi A, Hodges PW, Bennell KL. Hip Abductor Muscle Weakness in Individuals with Gluteal Tendinopathy. *Med Sci Sports Exerc*. 2016; 48: 346–352. <https://doi.org/10.1249/MSS.0000000000000781> PMID: 26418561
14. Allison K, Wrigley T V., Vicenzino B, Bennell KL, Grimaldi A, Hodges PW. Kinematics and kinetics during walking in individuals with gluteal tendinopathy. *Clin Biomech*. 2016; 32: 56–63. <https://doi.org/10.1016/j.clinbiomech.2016.01.003> PMID: 26827150
15. Yamato T, Maher C, Saragiotto B, Moseley A, Hoffmann T, Elkins M, et al. The TiDieR checklist will benefit the physiotherapy profession. *Physiother Theory Pract*. 2017; 33: 267–268. <https://doi.org/10.1080/09593985.2017.1304065> PMID: 28443788

16. Chan A-W, Tetzlaff JM, Altman DG, Laupacis A, Gøtzsche PC, Krleža-Jerić K, et al. SPIRIT 2013 Statement: Defining Standard Protocol Items for Clinical Trials. *Ann Intern Med.* 2013; 158: 200. <https://doi.org/10.7326/0003-4819-158-3-201302050-00583> PMID: 23295957
17. Barratt PA, Brookes N, Newson A. Conservative treatments for greater trochanteric pain syndrome: a systematic review. *Br J Sports Med.* 2017; 51: 97–104. <https://doi.org/10.1136/bjsports-2015-095858> PMID: 27834675
18. Mellor R, Grimaldi A, Wajswelner H, Hodges P, Abbott JH, Bennell K, et al. Exercise and load modification versus corticosteroid injection versus 'wait and see' for persistent gluteus medius/minimus tendinopathy (the LEAP trial): a protocol for a randomised clinical trial. *BMC Musculoskelet Disord.* 2016; 17: 196. <https://doi.org/10.1186/s12891-016-1043-6> PMID: 27139495
19. Fearon AM, Scarvell JM, Neeman T, Cook JL, Cormick W, Smith PN. Greater trochanteric pain syndrome: defining the clinical syndrome. *Br J Sports Med.* 2013; 47: 649–653. <https://doi.org/10.1136/bjsports-2012-091565> PMID: 22983121
20. Grimaldi A, Mellor R, Nicolson P, Hodges P, Bennell K, Vicenzino B. Utility of clinical tests to diagnose MRI-confirmed gluteal tendinopathy in patients presenting with lateral hip pain. *Br J Sports Med.* 2017; 51: 519–524. <https://doi.org/10.1136/bjsports-2016-096175> PMID: 27633027
21. Speers CJ, Bhogal GS. Greater trochanteric pain syndrome: a review of diagnosis and management in general practice. *Br J Gen Pract.* 2017; 67: 479–480. <https://doi.org/10.3399/bjgp17X693041> PMID: 28963433
22. Ostelo RWJG, de Vet HCW, Vlaeyen JWS, Kerckhoffs MR, Berfelo WM, Wolters PMJC, et al. Behavioral Graded Activity Following First-Time Lumbar Disc Surgery. *Spine (Phila Pa 1976).* 2003; 28: 1757–1765. <https://doi.org/10.1097/01.BRS.0000083317.62258.E6> PMID: 15662744
23. Garcia SC, Dueweke JJ, Mendias CL. Optimal Joint Positions for Manual Isometric Muscle Testing. *J Sport Rehabil.* 2016; 25. <https://doi.org/10.1123/jsr.2015-0118> PMID: 27632883
24. Picha KJ, Almaddah MR, Barker J, Ciochetty T, Black WS, Uhl TL. Elastic Resistance Effectiveness on Increasing Strength of Shoulders and Hips. *J Strength Cond Res.* 2019; 33: 931–943. <https://doi.org/10.1519/JSC.0000000000002216> PMID: 28922213
25. Zapparoli FY, Riberto M. Isokinetic Evaluation of the Hip Flexor and Extensor Muscles: A Systematic Review. *J Sport Rehabil.* 2017; 26: 556–566. <https://doi.org/10.1123/jsr.2016-0036> PMID: 27992245
26. Sehn F, Chachamovich E, Vidor LP, Dall-Agnol L, Custódio de Souza IC, Torres ILS, et al. Cross-Cultural Adaptation and Validation of the Brazilian Portuguese Version of the Pain Catastrophizing Scale. *Pain Med.* 2012; 13: 1425–1435. <https://doi.org/10.1111/j.1526-4637.2012.01492.x> PMID: 23036076
27. Siqueira FB, Teixeira-Salmela LF, de C Magalhães L. Análise das propriedades psicométricas da versão brasileira da escala tampa de cinesiofobia. *Acta Ortopédica Bras.* 2007; 15: 19–24. <https://doi.org/10.1590/S1413-78522007000100004>
28. Caumo W, Antunes L, Lorenzini Elkfury J, Herbstrith E, Busanello Sipmann R, Souza A, et al. The Central Sensitization Inventory validated and adapted for a Brazilian population: psychometric properties and its relationship with brain-derived neurotrophic factor. *J Pain Res.* 2017; Volume 10: 2109–2122. <https://doi.org/10.2147/JPR.S131479> PMID: 28979158
29. Polesello GC, Godoy GF, de C Trindade CA, de Queiroz MC, Honda E, Ono NK. Translation and cross-cultural adaptation of the International Hip Outcome Tool (iHOT) into Portuguese. *Acta Ortop Bras.* 2012; 20: 88–92B. PMID: 24453587
30. Kraemer WJ, Adams K, Cafarelli E, Dudley GA, Dooly C, Feigenbaum MS, et al. Progression models in resistance training for healthy adults. *Med Sci Sports Exerc.* 2002; 34: 364–380. <https://doi.org/10.1097/00005768-200202000-00027> PMID: 11828249
31. Krueger C, Tian L. A Comparison of the General Linear Mixed Model and Repeated Measures ANOVA Using a Dataset with Multiple Missing Data Points. *Biol Res Nurs.* 2004; 6: 151–157. <https://doi.org/10.1177/1099800404267682> PMID: 15388912
32. Tingley D, Yamamoto T, Hirose K, Keele L, Imai K. Mediation: R Package for Causal Mediation Analysis. *J Stat Softw.* 2014; 59.
33. Altman DG. The Revised CONSORT Statement for Reporting Randomized Trials: Explanation and Elaboration. *Ann Intern Med.* 2001; 134: 663. <https://doi.org/10.7326/0003-4819-134-8-200104170-00012> PMID: 11304107
34. Elkins MR, Moseley AM. Intention-to-treat analysis. *J Physiother.* 2015; 61: 165–167. PMID: 26096012
35. Rio E, Kidgell D, Purdam C, Gaida J, Moseley GL, Pearce AJ, et al. Isometric exercise induces analgesia and reduces inhibition in patellar tendinopathy. *Br J Sports Med.* 2015; 49: 1277–1283. <https://doi.org/10.1136/bjsports-2014-094386> PMID: 25979840

ARTIGO 2

Motor control exercises versus general exercises on pain in women with Greater trochanteric pain syndrome: A randomized controlled trial with 8 and 60 weeks follow-up

Guilherme Thomaz de Aquino Nava¹, Caroline Baldini Prudencio², Rafael Krasic Alaiti³, Beatriz Mendes Tozim⁴, Rebecca Mellor⁵, Cristiane Rodrigues Pedroni^{1,4}, Angélica Mércia Pascon Barbosa^{2,4}, Marcelo Tavella Navega^{1,4}

¹ Department of Physical Education, Institute of Biosciences, São Paulo State University (UNESP), Rio Claro, São Paulo, Brazil

² Department of Gynecology and Obstetrics, Botucatu Medical School, São Paulo State University (UNESP), Botucatu, São Paulo, Brazil

³ Nucleus of Neuroscience and Behavior and Nucleus of Applied Neuroscience, Universidade de São Paulo (USP), São Paulo, Brazil

⁴ Department of Physiotherapy and Occupational Therapy, Faculty of Philosophy and Sciences, São Paulo State University (UNESP), Marília, São Paulo, Brazil

⁵ School of Health and Rehabilitation Sciences, The University of Queensland, Brisbane, Queensland, 4072, Australia

* Corresponding Author:

E-mail: gtanava@gmail.com (GTAN)

We intend to send the article to the journal: Journal of physiotherapy (Impact factor 10.714)

ABSTRACT

Introduction: Greater trochanteric pain syndrome (GTPS) defines pain in the greater trochanter region of the femur. GTPS has been related to weakness and poor control of the pelvis. It is known that exercise benefits people with GTPS, however, no studies have compared a motor control training versus general exercises. The study aims to compare the motor control group (MCG) and the general exercise group (GEG) on average pain at baseline, 8 and 60 weeks follow-up in women with GTPS. **Methods:** The study was approved by the Research Ethics Committee (CAAE: 87372318.1.0000.5406) and has been prospectively registered on the Brazilian Registry of Clinical Trials (RBR-37gw2x). Sixty participants were randomized to MCG or GEG. The participants were evaluated before treatment, after 8 and 60 weeks of intervention. The primary outcome measure was the average pain intensity, and secondary outcomes were global perceived effect, muscle strength, pain catastrophization, kinesiophobia, central sensitization, and quality of life. **Results:** No significant Time x Group interaction was observed with respect to average pain intensity over the previous week at 8 weeks (MD: -0.06; 95% CI -1.41 to 1.29; $p=0.92$, effect size= 0.02) or 60 weeks (MD: -0.75; 95% CI -2.35 to 0.83; $p=0.34$, effect size= 0.24). Regarding the secondary outcomes, only the muscle strength outcome showed a statistically significant difference when comparing the groups, specifically in the reassessment of the hip extensor muscles on the side without pain (MD: 0.1; 95% CI 0.0004 to 0.2 ; $p=0.04$; effect size = 0.54). **Conclusion:** The MCG was not superior to GEG to improve average pain intensity at baseline and after treatment, at 8 and 60 weeks, in women with GTPS.

.

INTRODUCTION

Greater trochanteric pain syndrome (GTPS) is a current and generic term to define pain or tenderness in the greater trochanter region of the femur(1,2). It is predominant in females, especially in women over 40 years of age, and it is known that 10 to 25% of the population will develop pain in the lateral region of the hip(2–7). Changes in the function of the hip abductor muscles, for example, weakness, mainly of the gluteus medius and gluteus minimus muscles, may be related to poor control of the pelvis, hip and culminate in abnormal control of the lower limbs, in addition to kinematic alteration of the trunk and the pelvis while walking(6,8–11).

Physical exercise benefits people with chronic pain(7), producing endogenous opioids and a consequent decrease in nociception(12,13). Furthermore, it is known that for GTPS, exercises are preferable to passive treatments(14,15). Taking into account the multifactorial etiology, it seems plausible that a treatment protocol that includes the correction of biomechanical factors associated with strengthening can contribute to the reduction of pain in women with GTPS.

Therefore, this study compared the average pain intensity at baseline and after treatment, at 8 and 60 weeks, in women with GTPS that participated in a motor control exercise program, focused on isometric and isotonic strengthening of the hip abductor and extensor muscles, associated with neuromuscular training of the lower limbs to improve the control of the pelvis in the frontal plane, to avoid hip adduction during walking and a general exercise program, containing warm-up, mobility exercises, stretching and strengthening the hip and trunk muscle groups(16). The hypothesis is that both protocols will show improvement, however, the MCG should be superior to the GEG because the exercises are specific to the hip region and focus on what the literature reports to be the main deficits in people with GTPS.

METHODS

This is a RCT, parallel with two arms, double-blind (both for evaluators and for the statistician), previously approved by the Research Ethics Committee of the São Paulo State University, Faculty of Philosophy and Sciences, Campus of Marília (CAAE: 87372318.1.0000.5406), with the approved study protocol(16). The RCT was previously registered in the Brazilian Registry of Clinical Trials (RBR-37gw2x). All participants sign the informed consent form before starting treatment.

Participants

Women with GTPS were recruited in the city of Marília (Universities and public health services), through social media (Facebook, Instagram, WhatsApp, and websites), and through written dissemination (flyers). Women interested in participating in the study were able to contact the principal investigator by phone, email, or social media. Eligibility criteria were: age between 18 and 70, practicing physical activity up to two days a week, and presenting lateral hip pain for more than 3 months. In addition, the participants should report pain in the lateral region of the hip in at least one of the seven activities: walking, prolonged standing, standing up from the seated position, prolonged sitting, climbing stairs, climbing up hills or slopes, and side-lying. The non-eligibility criteria were: have a body mass index (BMI) $> 36\text{kg} / \text{m}^2$, have received some type of invasive intervention for lateral hip pain, corticosteroid injection (CSI), or physical therapy intervention for their hip pain in the last 12 weeks, have morning stiffness, any disease affecting the neuromuscular system or that may prevent data collection, have had spinal or hip surgery, any infectious condition, any neoplasm or cannot commit to participating for the duration of treatment(11,15,17–19).

Randomisation

Participants were initially screened by phone or whatsapp and subsequently through face-to-face evaluation to determine whether they met the eligibility criteria. Prior to the baseline evaluation (T0), participants were randomized via www.sealedenvelope.com, using block-randomization, into the following groups(16):

- Motor control group (MCG)
- General exercises group (GEG)

Study treatments

Motor control exercises were performed twice a week for 8 weeks. Each session varied between 50-60 minutes of individualized, face-to-face treatment, and accompanied by a physical therapist. During the treatment sessions, the participants performed isometric and isotonic strengthening of the hip abductor and extensor muscles, associated with neuromuscular training of the lower limbs to improve the control of the pelvis in the frontal plane, to avoid hip adduction during walking(16).

General exercises were performed twice a week for 8 weeks. Each session varied between 50-60 minutes of individualized, face-to-face treatment, and accompanied by a physical therapist. Each treatment session was started by warming up with walking for 5 minutes. Subsequently, the participants performed stretching, exercises to gain mobility and isotonic strengthening of the trunk, hip and lower limbs muscles(16).

Outcomes

The primary outcome evaluated was the average pain intensity over the previous week using the Visual Analogic Scale (VAS). To define pain intensity, participants were instructed to indicate the average pain intensity in the last week(5). A ruler was used to measure the value obtained(5). It was assessed at baseline, 8 and 60 weeks after treatment.

For the evaluation of secondary outcomes, the following were used:

The scale of Global Perceived Effect (GPE), assesses the participants' perception of improvement after treatment(20). It was assessed at 8 and 60 weeks after treatment.

The isometric strength of the hip abductor and extensor muscles was evaluated by a manual muscle tester (Lafayette Instruments)(21) and it was described in the study protocol(16). The peak force (Newtons) of the 3 contractions was recorded and the average of these values was used(19). The distance between the greater trochanter and the mid-point of the dynamometer placement (proximal to the lateral malleolus and above the popliteal fossa) was then measured (m). Torque (Nm) was then calculated by the equation $T = F (N) \times D (m)$, and then standardized to body weight (Nm/kg)(19). It was assessed at baseline and 8 weeks after treatment.

The pain catastrophization scale (PCS) was used to assess catastrophic thoughts, feelings, and behavior when in pain(22). It was assessed at baseline, 8 and 60 weeks after treatment.

Tampa Scale for Kinesiophobia (TSK) was used to assess “excessive, irrational, and debilitating fear of movement and physical activity, resulting in feelings of vulnerability to pain or fear of recurrence of the injury”(23). It was assessed at baseline, 8 and 60 weeks after treatment.

Central sensitization inventory (CSI) was used to screen participants at high risk for central sensitization or to assess symptoms related to central sensitization(24). It was assessed at baseline, 8 and 60 weeks after treatment.

The International Hip Outcome Tool (iHOT) was used to evaluate the quality of life of people with hip pain(25). It was assessed at baseline, 8 and 60 weeks after treatment.

Sample size

The sample size calculation was performed through the G * Power software. It was based on the ability to detect a difference of 2 points (pilot standard deviation of $\pm 0,8$ points) of pain intensity score because it is the primary outcome of the research. A power of 0.80, probability of error α 0.05, effect size of 0,48 and a 15% dropout rate were used, thus we will recruit 60 participants (30 in each group)(14).

Statistical analysis

The study was run as a superiority trial. The statistical analysis followed the intention-to-treat concept. For missing data, imputation was performed using the average values. Statistical analysis was performed using the software IBM SPSS Statistics for Windows, version 20.0 (IBM Corp., Armonk, N.Y., USA) and the statistician was blinded. Data were evaluated using exploratory statistical techniques.

Firstly, the normality and homogeneity of the data were verified and then the appropriate statistical analyses were adopted for the variables. The between-group differences for the primary and secondary outcomes and their respective confidence intervals at 95% were calculated by constructing mixed linear models. “Time” and “group” were considered fixed effects, whereas the participants were considered the

random effect. The time by group interaction were included in the analysis to assess the difference effect between the groups at 8 and 60 weeks follow-up, and the dependent variable baseline value were included as a covariate for the correction of possible differences(26). The significance level was 0.05 for all statistical analyses.

RESULTS

Between March 2019 and March 2022, 330 women were evaluated, 60 met the selection criteria and were invited to participate in the RCT. Thirty participants were randomized to MCG, and thirty to GEG. The trial was completed in March 2023, 60 weeks after the completion of the last participant's 8-week exercise program.

Of the 60 women who started treatment, 57 (95%) completed all follow-ups (8 and 60 weeks), and only 3 of them dropped out of the study (1 in the MCG and 2 in the GEG), however, all were included in the study due to intention-to-treat analysis (figure 1). One participant, from the MCG, reported having started training at the gym simultaneously with the physiotherapeutic treatment.

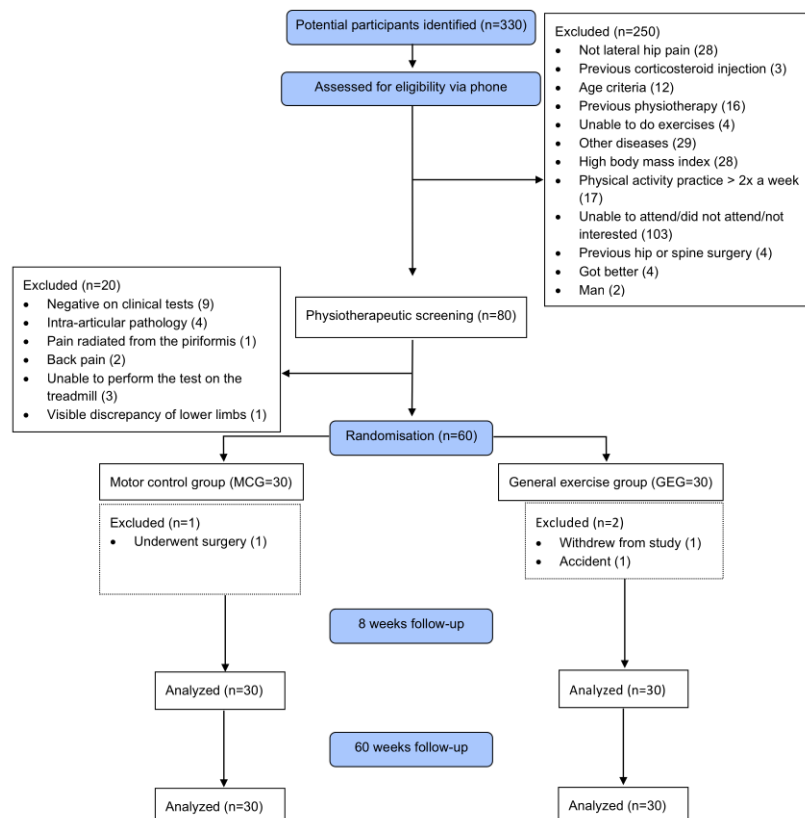


Figure 1. Flow of participants throughout trial

The characteristics of the participants are shown in Table 1. The groups were similar at baseline for all evaluated characteristics. No participant or practitioner reported a serious adverse event.

Table 1. Baseline descriptive characteristics of trial participants, by treatment group.

	All participants (n=60)	MCG (n=30)	GEG (n=30)
Age, years*	49,2 (12,3)	50,2 (12,2)	47,5 (12,3)
Symptom duration, years*	4,7 (5,5)	5,4 (5,3)	4,0 (5,7)
Height, m*	1,6 (0,6)	1,6 (0,1)	1,6 (0,1)
Weight, kg*	75,6 (10,8)	73,8 (10,1)	77,8 (11,1)
BMI*	28,8 (3,7)	28,2 (3,5)	29,7 (3,8)
Number of sessions*	15,0 (2,6)	15,3 (1,6)	14,8 (3,3)
Average pain intensity (0-10 points)*	5,8 (2,3)	5,9 (2,7)	5,7 (2,0)
Gluteal muscle torque, Nm/kg*			
Hip abductor with pain*	0,8 (0,2)	0,8 (0,2)	0,8 (0,2)
Hip abductor without pain*	0,8 (0,2)	0,8 (0,2)	0,9 (0,3)
Hip extensor with pain*	0,5 (0,2)	0,5 (0,2)	0,6 (0,3)
Hip extensor without pain*	0,6 (0,2)	0,6 (0,2)	0,6 (0,3)
City			
Marília	56 (93,3%)	28 (93,3%)	28 (93,3%)
Garça	1 (1,7%)	1 (3,3%)	-
Oriente	2 (3,3%)	1 (3,3%)	1 (3,3%)
Platina	1 (1,7%)	-	1 (3,3%)
Race			
Caucasian	48 (80%)	26 (86,7%)	22 (73,3%)
Non-caucasian	12 (20%)	4 (13,3%)	8 (26,7%)
Education level			
Incomplete high school or less	7 (11,7%)	3 (10%)	4 (13,3%)
Complete high school	20 (33,3%)	11 (36,7%)	9 (30%)
Incomplete graduation	10 (16,7%)	4 (13,3%)	6 (20%)
Complete graduation	23 (38,3%)	12 (40%)	11 (36,7%)
Pain			
Unilateral	35 (58,3%)	16 (53,3%)	19 (63,3%)
Bilateral	25 (41,7%)	14 (46,7%)	11 (36,7%)
Provocative clinical pain tests			
Hip FADER	50 (83,3%)	26 (86,7%)	24 (80%)
Hip FADER-R	50 (83,3%)	26 (86,7%)	24 (80%)
Patrick-Faber	56 (93,3%)	27 (90%)	29 (96,7%)
ADD	50 (83,3%)	26 (86,7%)	24 (80%)
ADD-R	44 (73,3%)	23 (76,7%)	21 (70%)
Single leg stance	54 (90%)	28 (93,3%)	26 (86,7%)
Trendelenburg	26 (43,3%)	17 (56,7%)	9 (30%)

*Data are mean (standard deviation); MCG: Motor control group; GEG: General exercise group; BMI:

Body mass index; Nm/kg: Torque (Nm) standardized to body weight.

Primary outcome

No significant Time x Group interaction was observed with respect to average pain intensity over the previous week at 8 weeks (MD: -0.06; 95% CI -1.41 to 1.29; $p=0.92$, effect size= 0.02) or 60 weeks (MD: -0.75; 95% CI -2.35 to 0.83; $p=0.34$, effect size= 0.24) (table 2).

Secondary outcomes

No significant Time x Group interaction was observed with respect to GPE (MD: 0.142; 95% CI -0.14 to 0.42; $p= 0.66$, effect size= 0.26) at 8 weeks. Regarding muscle strength, the same occurred with hip abductor with pain (MD: 0.02; 95% CI -0.5 to 0.09; $p=0.59$; effect size =0,37), hip abductor without pain (MD: 0.002; 95% CI -0.08 to 0.09; $p=0.95$; effect size= 0,01) and, hip extensor with pain (MD: -0.01; 95% CI -0.122 to 0.1; $p=0.84$; effect size: 0,49), but the hip extensor without pain showed differences between groups (MD: 0.1; 95% CI 0.0004 to 0.2; $p=0.04$; effect size = 0,54). No significant Time x Group interaction was observed with respect to pain catastrophizing (MD: -1.91; 95% CI -8.34 to 4.52; $p= 0.55$, effect size= 0.15), kinesiophobia (MD: -2.94; 95% CI -6.89 to 1.02; $p= 0.14$, effect size= 0.38), central sensitization (MD: -0.96; 95% CI -6.16 to 4.22; $p=0.77$, effect size= 0.09), and quality of life (MD: 3.09; 95% CI -6.91 to 13; $p= 0.54$, effect size= 0.16) at 8 weeks follow-up. No significant Time x Group interaction was observed with respect to GPE (MD: -0.27; 95% CI -0.61 to 0.06; $p= 0.11$, effect size= 0.41), pain catastrophizing (MD: -1.85; 95% CI -8.92 to 5.21; $p= 0.6$, effect size= 0.13), kinesiophobia (MD: -1.19; 95% CI -5.36 to 2.98; $p= 0.5$, effect size= 0.14), central sensitization (MD: 1.14; 95% CI -4.15 to 6.43; $p= 0.67$; effect size= 0.11) or quality of life (MD: 8.79; 95% CI -4.67 to 22.2; $p= 0.19$, effect size= 0.33) at 60 weeks follow-up (table 3).

Table 2. Primary Outcome

	Baseline		8 weeks		Adjusted between- groups mean difference (95% CI)	Effect size as SMD*	60 weeks		Adjusted between- groups mean difference (95% CI)	Effect size as SMD*
	MCG (n=30)	GEG (n=30)	MCG (n=30)	GEG (n=30)			MCG (n=30)	GEG (n=30)		
Pain Intensity (0-10)	5,9 (2,7)	5,7 (2,0)	1,7 (2,1)	1,5 (1,4)	(-0.06 (-1.41 to 1.29))	0.02	2,7 (2,7)	1,8 (2,4)	(-0.75 (-2.35 to 0.83))	0.24

* Standardized mean difference (SMD) calculated from marginal estimates (Cohen d); P< 0.05; MCG: Motor control group; GEG: General exercise group

Table 3. Secondary Outcomes

	Baseline		8 weeks		Adjusted between- groups mean difference (95% CI)	Effect size as SMD*	60 weeks		Adjusted between- groups mean difference (95% CI)	Effect size as SMD*
	MCG (n=30)	GEG (n=30)	MCG (n=30)	GEG (n=30)			MCG (n=30)	GEG (n=30)		
Global Perceived Effect	-	-	2,0 (0,6)	2,1 (0,5)	0.142 (-0.14 to 0.42)	0.26	2,3 (0,9)	2,1 (0,5)	(-0.27 (-0.61to 0.06))	0.41
Muscle Strength										
Hip abductor with pain	0,8 (0,2)	0,8 (0,2)	0,9 (0,2)	0,9 (0,2)	0.02 (-0.05 to 0.09)	0.37	-	-	-	-
Hip abductor without pain	0,8 (0,2)	0,9 (0,3)	0,9 (0,2)	1,0 (0,3)	0.002 (-0.08 to 0.09)	0.01	-	-	-	-
Hip extensor with pain	0,5 (0,2)	0,6 (0,3)	0,7 (0,2)	0,7 (0,3)	(-0.01(-0.12 to 0.1))	0.49	-	-	-	-
Hip extensor without pain	0,6 (0,2)	0,6 (0,3)	0,6 (0,2)	0,8 (0,3)	0.1 (0.0001 to 0.004)	0.54*	-	-	-	-
Catastrophizing	28,2 (11,2)	27,3 (10,9)	17,2 (11,3)	14,4 (12,5)	(-1.91 (-8.34 to 4.52))	0.15	18,1 (14,1)	15,3 (12,0)	(-1.85 (-8.92 to 5.21))	0.13
Kinesiophobia	36,9 (6,5)	37,9 (8,4)	31,8 (6,2)	29,7 (6,9)	(-2.94 (-6.89 to 1.02))	0.38	33,9 (8,3)	33,4 (7,7)	(-1.19 (-5.36 to 2.98))	0.14
Central Sensitization	47,0 (12,5)	44,5 (13,6)	37,0 (14,5)	33,2 (13,7)	(-0.96 (-6.16 to 4.22))	0.09	41,2 (13,5)	39,5 (14,9)	1.14 (-4.15 to 6.43)	0.11
Quality of life	32,8 (17,2)	28,1 (15,1)	69,4 (21,8)	68,0 (20,7)	3.09 (-6.91 to 13)	0.16	60 (28,7)	64,2 (24,9)	8.79 (-4.67 to 22.2)	0.33

* Standardized mean difference (SMD) calculated from marginal estimates (Cohen d); P< 0.05;

MCG: Motor control group; GEG: General exercise group.

DISCUSSION

According to the results of the study, we can say that our hypothesis was refuted. The MCG was not superior than the GEG to improve pain intensity. This was an individualized RCT with the presence of the physical therapist in all sessions and done in the clinical setting. This RCT showed that an 8-week progressive abductor and extensor hip strengthening associated with neuromuscular training of the lower limbs to improve the control of the pelvis, emphasizing pelvic alignment, especially in the frontal plane, to reduce hip adduction during walking was capable to reduced pain intensity, catastrophizing, kinesiophobia, central sensitization, and improved quality of life intra-group, as well as the GEG, however, there was no significant effect between groups at 8 and 60 weeks follow-up. The GPE was also not different between groups. Related to the muscle strength, there was a significant effect only on the strength of the hip extensor muscle in the painless leg ($p=0,04$) in the GEG.

Regarding the pain intensity, Ganderton et al 2018 also found no differences between an exercise program focused on isometric loading of the gluteus medius and minimus, and kinetic chain (quadriceps and calf muscle) strengthening exercises, and a sham group that predominately involved seated exercises not aimed at therapeutic loading of the gluteal tendons or strengthening of the kinetic chain at 12 and 52-weeks follow-ups(17). A study by Clifford et al. 2019(7) compared an isometric and an isotonic group for GTPS(7). No difference was found in pain intensity between groups after 12 weeks, also in agreement with our results. A study conducted by Mellor et al 2018 found that education plus exercise and CSI was better than wait and see approach related to pain intensity, with a better result for education plus exercise at 8-week follow-up, however, at 52 weeks, education plus exercise and CSI showed similar results(14). Rompe et al 2009 compared home exercise with CSI and Radial Shockwave Therapy (RST) and

found, respectively, 7%, 75%, and 13% of pain decreased at 1 month, 41%, 51%, and 68% at 4 months, and 80%, 48% and 74% at 15 months follow-up(15).

The analysis of the secondary outcomes showed that both MCG and GEG generate similar results in GPE, pain catastrophizing, kinesiophobia, central sensitization, and quality of life, thus, these secondary outcomes are equally supportive of both studied protocols in the decision-making process. The MCG and the GEG showed similar results regarding to the GPE, the punctuation was 2.0 and 2.1 at 8 weeks and, 2.3 and 2.1 at 60 weeks, respectively. GPE is rated on a 7-point scale (1 = completely recovered, 7 = worse than ever)(20). These ratings were dichotomized into: improved [completely recovered (1) and much improved (2)] versus not improved [slightly improved (3), not changed (4), slightly worsened (5), much worsened (6), worse than ever (7)], demonstrating both groups were able to recover(20). This corroborates the findings of Ganderton et al. 2018(17) that showed no differences between groups.

Muscle strength showed similar baseline values compared to Mellor et al 2018. This study showed that a therapy based on education plus exercise was better than a “wait and see” approach to hip abductor strength at 8 weeks follow-up(14). They also compared education plus exercise with CSI, but no differences were observed(14). In our study, it was compared two therapies based on exercises. Despite the increase in intra-group muscle strength, a statistically significant difference ($p=0,04$) was only observed between the groups in assessing the strength of the hip extensor muscles on the side without pain.

To date, no RCT has compared the outcomes of kinesiophobia and central sensitization in people with GTPS, demonstrating that interest in the subject is recent and based on biomechanics not taking into account psychological factors. However, it is known that psychosocial factors are important predictors of pain and both physical and psychological functioning(27). Our findings showed scores of kinesiophobia within the

normal range (29-43 points) that remain in the normal range after treatment. A cross-sectional study by Ferrer-Peña et al. 2019 showed no correlation between kinesiophobia and dynamic balance in people with GTPS, even in higher values of kinesiophobia(27).

As for central sensitization data, MCG and GEG were classified as moderate (pontuation between 40-49) at baseline and were reclassified as mild (pontuation between 30-39) at 8-week follow-up. At 60 weeks follow-up MCG returned to moderate. A study by Ferrer-Peña et al. 2018, aimed to discover the association between pain expansion, pain severity, and pain-related central sensitization somatosensory variables in patients with GTPS(28). They found that 34.7% of patients showed negative conditioned pain modulation which suggests that central mechanisms may be involved in these patients as temporal summation is a hallmark sign from the brainstem(28).

Pain catastrophizing and quality of life were not different between groups, as seems a previous study(17). The study by Mellor et al. 2018(14) showed that the education plus exercise group improved the quality of life when compared to CSI, and showed improvement in quality of life and pain catastrophizing when compared with a wait and see approach(14). A recent study(29) showed that factors such as higher pain catastrophizing and poorer quality of life are common findings in people with GTPS, especially in the subgroup with more severe disability characteristics(29).

Our results suggest that, although there was no difference between groups, an exercise strategy focused on strengthening the hip abductor and extensor muscles, with neuromuscular training to prevent hip adduction during walking, and general exercise, including a warm-up in the walking, strengthening and stretching of the trunk and lower limbs were beneficial for women with GTPS. Therefore, both treatments can be chosen for the rehabilitation of women with GTPS.

The main limitation of the present study was that the therapist was not blinded to the treatment assignment as usual in exercise-based protocol RCTs. Another limitation is that all participants were evaluated and/or treated during the coronavirus pandemic, which may have influenced the results, with four participants in the MCG absent due to suspicion or to recover from covid-19 and one to recover from dengue. The same occurred in the GEG, one was absent due to suspicion of covid-19 and one was due to recover from dengue. Despite the challenges imposed by the pandemic, the study proved to be viable, mainly because it was individualized, and the treatments were well accepted by participants as demonstrated by the high retention rates and no major adverse events.

CONCLUSION

The MCG was not superior to GEG to improve average pain intensity at baseline and after treatment, at 8 and 60 weeks, in women with GTPS.

REFERENCES

1. Ho GWK, Howard TM. Greater trochanteric pain syndrome: More than bursitis and iliotibial tract friction. *Curr Sports Med Rep*. 2012;11(5):232–8.
2. Reid D. The management of greater trochanteric pain syndrome: A systematic literature review. *J Orthop*. 2016;13(1):15–28.
3. Williams BS, Cohen SP. Greater trochanteric pain syndrome: A review of anatomy, diagnosis and treatment. *Anesth Analg*. 2009;108(5):1662–70.
4. Grimaldi A, Mellor R, Hodges P, Bennell K, Wajswelner H, Vicenzino B. Gluteal Tendinopathy: A Review of Mechanisms, Assessment and Management. *Sport Med*. 2015;45(8):1107–19.
5. Ganderton C, Semciw A, Cook J, Pizzari T. Does menopausal hormone therapy (MHT), exercise or a combination of both, improve pain and function in post-menopausal women with greater trochanteric pain syndrome (GTPS)? A randomised controlled trial. *BMC Womens Health* [Internet]. 2016 Dec 16;16(1):32. Available from: <http://bmcwomenshealth.biomedcentral.com/articles/10.1186/s12905-016-0311-9>
6. Ganderton C, Semciw A, Cook J, Pizzari T. Demystifying the Clinical Diagnosis of Greater Trochanteric Pain Syndrome in Women. *J Women's Heal* [Internet]. 2017 Jun;26(6):633–43. Available from: <http://www.liebertpub.com/doi/10.1089/jwh.2016.5889>
7. Clifford C, Paul L, Syme G, Millar NL. Isometric versus isotonic exercise for greater trochanteric pain syndrome: a randomised controlled pilot study. *BMJ Open Sport Exerc Med* [Internet]. 2019 Sep 21;5(1):e000558. Available from: <https://bmjopensem.bmj.com/lookup/doi/10.1136/bmjsem-2019-000558>
8. Ganderton C, Pizzari T, Harle T, Cook J, Semciw A. A comparison of gluteus

- medius , gluteus minimus and tensor facia latae muscle activation during gait in post-menopausal women with and without greater trochanteric pain syndrome q. *J Electromyogr Kinesiol.* 2017;33:39–47.
9. Allison K, Salomoni SE, Bennell KL, Wrigley T V., Hug F, Vicenzino B, et al. Hip abductor muscle activity during walking in individuals with gluteal tendinopathy. *Scand J Med Sci Sports* [Internet]. 2018 Feb;28(2):686–95. Available from: <http://doi.wiley.com/10.1111/sms.12942>
 10. Allison K, Vicenzino B, Wrigley T V., Grimaldi A, Hodges PW, Bennell KL. Hip Abductor Muscle Weakness in Individuals with Gluteal Tendinopathy. *Med Sci Sports Exerc.* 2016;48(3):346–52.
 11. Allison K, Wrigley T V., Vicenzino B, Bennell KL, Grimaldi A, Hodges PW. Kinematics and kinetics during walking in individuals with gluteal tendinopathy. *Clin Biomech* [Internet]. 2016;32:56–63. Available from: <http://dx.doi.org/10.1016/j.clinbiomech.2016.01.003>
 12. Stagg NJ, Mata HP, Ibrahim MM, Henriksen EJ, Porreca F, Vanderah TW, et al. Regular Exercise Reverses Sensory Hypersensitivity in a Rat Neuropathic Pain Model. *Anesthesiology* [Internet]. 2011 Apr 1;114(4):940–8. Available from: <https://pubs.asahq.org/anesthesiology/article/114/4/940/10465/Regular-Exercise-Reverses-Sensory-Hypersensitivity>
 13. Mayer J, Mooney V, Dagenais S. Evidence-informed management of chronic low back pain with lumbar extensor strengthening exercises. *Spine J* [Internet]. 2008 Jan;8(1):96–113. Available from: <https://linkinghub.elsevier.com/retrieve/pii/S1529943007008716>
 14. Mellor R, Bennell K, Grimaldi A, Nicolson P, Kasza J, Hodges P, et al. Education plus exercise versus corticosteroid injection use versus a wait and see

- approach on global outcome and pain from gluteal tendinopathy: Prospective, single blinded, randomised clinical trial. *Br J Sports Med.* 2018;52(22):1464–72.
15. Rompe JD, Segal NA, Cacchio A, Furia JP, Morral A, Maffulli N. Home Training, Local Corticosteroid Injection, or Radial Shock Wave Therapy for Greater Trochanter Pain Syndrome. *Am J Sports Med.* 2009;37(10):1981–90.
 16. Thomaz de Aquino Nava G, Baldini Prudencio C, Krasic Alaiti R, Mendes Tozim B, Mellor R, Rodrigues Pedroni C, et al. Motor control exercises versus general exercises for greater trochanteric pain syndrome: A protocol of a randomized controlled trial. Vousden G, editor. *PLoS One* [Internet]. 2022 Jun 24;17(6):e0269230. Available from: <https://dx.plos.org/10.1371/journal.pone.0269230>
 17. Ganderton C, Semciw A, Cook J, Moreira E, Pizzari T. Gluteal Loading Versus Sham Exercises to Improve Pain and Dysfunction in Postmenopausal Women with Greater Trochanteric Pain Syndrome: A Randomized Controlled Trial. *J Women’s Heal* [Internet]. 2018 Jun;27(6):815–29. Available from: <http://www.liebertpub.com/doi/10.1089/jwh.2017.6729>
 18. Barratt PA, Brookes N, Newson A. Conservative treatments for greater trochanteric pain syndrome: a systematic review. *Br J Sports Med.* 2017;51(2):97–104.
 19. Mellor R, Grimaldi A, Wajswelner H, Hodges P, Abbott JH, Bennell K, et al. Exercise and load modification versus corticosteroid injection versus ‘wait and see’ for persistent gluteus medius/minimus tendinopathy (the LEAP trial): a protocol for a randomised clinical trial. *BMC Musculoskelet Disord.* 2016;17(1):196.
 20. Ostelo RWJG, de Vet HCW, Vlaeyen JWS, Kerckhoffs MR, Berfelo WM,

- Wolters PMJC, et al. Behavioral Graded Activity Following First-Time Lumbar Disc Surgery. *Spine (Phila Pa 1976)* [Internet]. 2003 Aug;28(16):1757–65. Available from: <http://journals.lww.com/00007632-200308150-00001>
21. Garcia SC, Dueweke JJ, Mendias CL. Optimal Joint Positions for Manual Isometric Muscle Testing. *J Sport Rehabil* [Internet]. 2016 Nov 1;25(4). Available from: <https://journals.humankinetics.com/view/journals/jsr/25/4/article-jsr.2015-0118.xml.xml>
 22. Sehn F, Chachamovich E, Vidor LP, Dall-Agnol L, Custódio de Souza IC, Torres ILS, et al. Cross-Cultural Adaptation and Validation of the Brazilian Portuguese Version of the Pain Catastrophizing Scale. *Pain Med* [Internet]. 2012;13(11):1425–35. Available from: <https://academic.oup.com/painmedicine/article-lookup/doi/10.1111/j.1526-4637.2012.01492.x>
 23. Siqueira FB, Teixeira-Salmela LF, Magalhães L de C. Análise das propriedades psicométricas da versão brasileira da escala tampa de cinesiofobia. *Acta Ortopédica Bras.* 2007;15(1):19–24.
 24. Caumo W, Antunes L, Lorenzzi Elkfury J, Herbstrith E, Busanello Sipmann R, Souza A, et al. The Central Sensitization Inventory validated and adapted for a Brazilian population: psychometric properties and its relationship with brain-derived neurotrophic factor. *J Pain Res.* 2017 Sep;Volume 10:2109–22.
 25. Polesello GC, Godoy GF, Trindade CA de C, de Queiroz MC, Honda E, Ono NK. Translation and cross-cultural adaptation of the International Hip Outcome Tool (iHOT) into Portuguese. *Acta Ortop Bras.* 2012;20(2):88-92B.
 26. Krueger C, Tian L. A Comparison of the General Linear Mixed Model and

- Repeated Measures ANOVA Using a Dataset with Multiple Missing Data Points. *Biol Res Nurs* [Internet]. 2004 Oct 26;6(2):151–7. Available from: <http://journals.sagepub.com/doi/10.1177/1099800404267682>
27. Ferrer-Peña R, Moreno-López M, Calvo-Lobo C, López-de-Uralde-Villanueva I, Fernández-Carnero J. Relationship of Dynamic Balance Impairment with Pain-Related and Psychosocial Measures in Primary Care Patients with Chronic Greater Trochanteric Pain Syndrome. *Pain Med* [Internet]. 2019 Apr 1;20(4):810–7. Available from: <https://academic.oup.com/painmedicine/article/20/4/810/5078129>
 28. Ferrer-Peña R, Muñoz-García D, Calvo-Lobo C, Fernández-Carnero J. Pain Expansion and Severity Reflect Central Sensitization in Primary Care Patients with Greater Trochanteric Pain Syndrome. *Pain Med* [Internet]. 2019 May 1;20(5):961–70. Available from: <https://academic.oup.com/painmedicine/article/20/5/961/5127121>
 29. Plinsinga ML, Coombes BK, Mellor R, Nicolson P, Grimaldi A, Hodges P, et al. Psychological factors not strength deficits are associated with severity of gluteal tendinopathy: A cross-sectional study. *Eur J Pain* [Internet]. 2018 Jul;22(6):1124–33. Available from: <https://onlinelibrary.wiley.com/doi/10.1002/ejp.1199>

ANEXOS

Anexo 1

Artigos publicados durante o doutorado

RESEARCH

Open Access



Viability of ex-vivo myography as a diagnostic tool for rectus abdominis muscle electrical activity collected at Cesarean section within a diamater cohort study

David R. A. Reyes^{1†}, Angelica M. P. Barbosa^{1,2†}, Floriano F. Juliana¹, Quiroz B. C. V. Sofia¹, Sarah M. B. Costa¹, Raghavendra L. S. Hallur^{1,3}, Eusebio M. A. Enriquez¹, Rafael G. Oliveira¹, Patricia de Souza Rossignolli², Cristiane Rodrigues Pedroni², Fernanda C. B. Alves¹, Gabriela A. Garcia¹, Joelcio F. Abbade¹, Carolina N. F. Carvalho¹, Luis Sobrevia^{1,4,5,6,7}, Marilza V. C. Rudge^{1*†}, Iracema I. M. P. Calderon^{1†} and The Diamater Study Group

[†]David R. A. Reyes and Angelica M. P. Barbosa are the first authors

[†]Marilza V. C. Rudge and Iracema I. M. P. Calderon are the last authors

*Correspondence:
marilzarudge@gmail.com

¹ Department of Gynecology and Obstetrics, Botucatu Medical School (FMB), São Paulo State University (UNESP), Botucatu, São Paulo CEP18618-687, Brazil
Full list of author information is available at the end of the article

Abstract

Background: *Ex-vivo* myography enables the assessment of muscle electrical activity response. This study explored the viability of determining the physiological responses in muscles without tendon, as rectus abdominis muscle (RAM), through *ex-vivo* myography to assess its potential as a diagnostic tool.

Results: All tested RAM samples (five different samples) show patterns of electrical activity. A positive response was observed in 100% of the programmed stimulation. RAM 3 showed greater weight (0.47 g), length (1.66 cm), and width (0.77 cm) compared to RAM 1, RAM 2, RAM 4 and RAM 5 with more sustained electrical activity over time, a higher percentage of fatigue was analyzed at half the time of the electrical activity. The order of electrical activity (Mn) was RAM 3 > RAM 5 > RAM 1 > RAM 4 > RAM 2. No electrical activity was recorded in the Sham group.

Conclusions: This study shows that it is feasible to assess the physiological responses of striated muscle without tendon as RAM, obtained at C-section, under *ex vivo* myography. These results could be recorded, properly analyzed, and demonstrated its potential as a diagnostic tool for rectus abdominis muscle electrical activity.

Keywords: Contractility, Rectus abdominis muscle, C-section, Myography, Skeletal muscle

Background

The Rectus Abdominis Muscle (RAM), a striated muscle without tendon, extending along the abdomen to the pubic symphysis, undergoes physiological adaptations during pregnancy [1–5]. As a striated muscle, the main focus of research has been on contractile muscle cells [6]. RAM has synergistic contractile activity with the pelvic floor



© The Author(s) 2022. **Open Access** This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>. The Creative Commons Public Domain Dedication waiver (<http://creativecommons.org/publicdomain/zero/1.0/>) applies to the data made available in this article, unless otherwise stated in a credit line to the data.

STUDY PROTOCOL

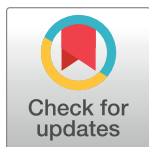
Effect of different electrostimulation currents on female urinary incontinence: A protocol of a randomized controlled trial

Raissa Escandiusi Avramidis¹, Angélica Mércia Pascon Barbosa^{2,3}, Guilherme Thomaz de Aquino Nava¹, Danielle Hikaru Nagami¹, Caroline Baldini Prudencio², Cristiane Rodrigues Pedroni^{1,3*}

1 Department of Physical Education, Institute of Biosciences of Rio Claro, São Paulo State University (UNESP), Rio Claro, São Paulo, Brazil, **2** São Paulo State University (Unesp), Postgraduate Program on Tocogynecology, Botucatu Medical School, Botucatu, Brazil, **3** São Paulo State University (Unesp), School of Philosophy and Sciences, Marília, Brazil

✉ These authors contributed equally to this work.

* cristiane.pedroni@unesp.br



OPEN ACCESS

Citation: Escandiusi Avramidis R, Barbosa AMP, Thomaz de Aquino Nava G, Hikaru Nagami D, Prudencio CB, Rodrigues Pedroni C (2022) Effect of different electrostimulation currents on female urinary incontinence: A protocol of a randomized controlled trial. PLoS ONE 17(12): e0276722. <https://doi.org/10.1371/journal.pone.0276722>

Editor: Jianhong Zhou, UNITED STATES

Received: July 23, 2021

Accepted: September 28, 2022

Published: December 1, 2022

Copyright: © 2022 Escandiusi Avramidis et al. This is an open access article distributed under the terms of the [Creative Commons Attribution License](https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Data Availability Statement: Deidentified research data will be made publicly available when the study is completed and published.

Funding: CBP: 2021/10665-6 São Paulo Research Foundation (FAPESP) - <https://fapesp.br/> The funders had and will not have a role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

Competing interests: The authors have declared that no competing interests exist.

Abstract

Introduction

Urgency urinary incontinence (UI) is characterized by involuntary urine leakage immediately after reporting of sudden, compelling desire to void. Electrostimulation and non-invasive neuromodulation have been considered as the first and third line of UI treatment but there is a lack of consensus on which parameters are more efficient. Thus, this study aims to compare the effect of low versus medium frequency currents on urinary incontinence severity and quality of life in women with UI complains.

Methods

It will be a randomized controlled trial with 5 arms, double-blinded (outcome assessor and statistician). The study was approved by the Research Ethics Committee (CAAE: 11479119.9.0000.5406) and has been prospectively registered on the Brazilian Registry of Clinical Trials (RBR-8bkp6). Concerning, double-blind process, the blinded assessor will be responsible for evaluate primary and secondary outcomes at baseline and follow-up without information about allocation and the statistician will perform analyses without information about group codification. One hundred and five participants will be randomized to receive: (1) Transcutaneous tibial nerve stimulation-low frequency, (2) Transcutaneous tibial nerve stimulation-high frequency, (3) Aussie median frequency, (4) Interferencial median frequency or (5) High voltage stimulation. The application will be performed during 20 sessions of 45-minutes, twice a week for 10 weeks, in groups of maximum 5 participants. The participants will be evaluated before treatment (baseline- 0 week), during the treatment (5 weeks) and after the last treatment session (10 weeks). The primary outcomes measures will be UI severity and quality of life, and the secondary outcome will be pelvic floor strength. Statistical analysis will be performed using SPSS software version 24.0 for Windows (IBM Corp., Armonk, N.Y., USA). The variables will be described by the mean and 95% confidence

STUDY PROTOCOL

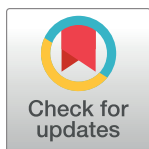
Effect of ischemic compressions versus extracorporeal shockwave therapy on myofascial trigger points: A protocol of a randomized controlled trial

Melissa Nahomi Kuroda¹*, Guilherme Thomaz de Aquino Nava¹, Caroline Baldini Prudencio², Daiane Affonso Paulo³, Isadora Peixoto³, Maiki Yoshi Moroshima³, Mariana de Almeida Lourenço⁴, Caroline Nogueira da Silva¹, Angélica Mércia Pascon Barbosa², Cristiane Rodrigues Pedroni²

1 Department of Physical Education, Institute of Biosciences, São Paulo State University (UNESP), Rio Claro, São Paulo, Brazil, **2** Department of Tocogynecology, Botucatu Medical School, São Paulo State University (UNESP), Botucatu, São Paulo, Brazil, **3** Department of Physiotherapy and Occupational Therapy, Faculty of Philosophy and Sciences, São Paulo State University (UNESP), Marília, São Paulo, Brazil, **4** Department of Physiotherapy, Educational Foundation of the City of Assis (FEMA), Assis, São Paulo, Brazil

* These authors contributed equally to this work.

* kurodamelissa@gmail.com



OPEN ACCESS

Citation: Nahomi Kuroda M, Thomaz de Aquino Nava G, Baldini Prudencio C, Affonso Paulo D, Peixoto I, Yoshi Moroshima M, et al. (2023) Effect of ischemic compressions versus extracorporeal shockwave therapy on myofascial trigger points: A protocol of a randomized controlled trial. PLoS ONE 18(3): e0283337. <https://doi.org/10.1371/journal.pone.0283337>

Editor: Juan Antonio Valera-Calero, Complutense University of Madrid: Universidad Complutense de Madrid, SPAIN

Received: July 27, 2022

Accepted: March 6, 2023

Published: March 30, 2023

Copyright: © 2023 Nahomi Kuroda et al. This is an open access article distributed under the terms of the [Creative Commons Attribution License](https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Data Availability Statement: No datasets were generated or analysed during the current study. All relevant data from this study will be made available upon request following study completion.

Funding: MNK (Finance Code 001): Coordenação de Aperfeiçoamento de Pessoal de Nível Superior, Brasil (CAPES) - Master's degree scholarship. <https://www.gov.br/capes/pt-br> The funders had

Abstract

Introduction

The myofascial trigger points (MTrPs) are hyperirritable nodules present in a tight muscle band. Among the symptoms, pain is one of the most common, but the individuals may have other sensory, motor, and autonomic changes. Athletes can have MTrPs more intensely due to the high physical and emotional demand. There are a variety of treatments, but not all have strong or moderate evidence of their effectiveness. Thus, the aim of this study is to compare the effects of ischemic compression (IC) and extracorporeal shockwave therapy (ESWT) on pressure pain threshold immediately after the intervention and after 48h.

Methods

This randomized clinical trial was registered in the Brazilian Registry of Clinical Trial (RBR-6wryhb9) and was approved by the Research Ethics Committee (CAAE 46682921.9.0000.5406). Forty participants will be randomized to receive IC or ESWT treatment once in each MTrPs. The protocol will consist of evaluations before (T0), immediate after (T1), and after forty-eight hours (T2) of the intervention. The primary outcome will be pressure pain threshold and the secondary outcomes will be jump height, muscle strength, dorsiflexion range of motion (ROM), the correlation between MTrPs and temperature and participant's satisfaction.

Conclusions

The IC and ESWT have been shown to be efficient in decreasing pain, however, the studies that compare the efficiency of these two treatments are limited in the literature, mainly in the

REGISTERED REPORT PROTOCOL

Effectiveness of the pelvic floor muscle training on muscular dysfunction and pregnancy specific urinary incontinence in pregnant women with gestational diabetes mellitus: A systematic review protocol

Angélica Mércia Pascon Barbosa^{1☯‡*}, Eusebio Mario Amador Enriquez^{2☯‡}, Meline Rossetto Kron Rodrigues^{3☯}, Caroline Baldini Prudencio^{2☯}, Álvaro Nagib Atallah^{4☯}, David Rafael Abreu Reyes^{2☯}, Raghavendra Lakshmana Shetty Hallur^{5☯}, Sthefanie Kenickel Nunes^{2☯}, Fabiane Affonso Pinheiro^{2☯}, Carlos Isaías Sartorão Filho^{2☯}, Gabriela Lopes Piemonte Andrade^{6☯}, Bary Berghmans^{6☯}, Rob de Bie^{6☯}, Silvana Andréa Molina Lima^{7☯‡}, Marilza Vieira Cunha Rudge^{2☯‡}, **The Diamater Study Group¹**

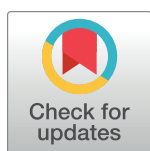
1 Department of Physiotherapy and Occupational Therapy, School of Philosophy and Sciences, São Paulo State University (UNESP), Marília, São Paulo State, Brazil, **2** Department of Gynecology and Obstetrics, Botucatu Medical School (FMB), São Paulo State University (UNESP), Botucatu, São Paulo State, Brazil, **3** Stricto Sensu Graduate Program in Nursing at UNIVERITAS, Guarulhos University (UNG), Guarulhos, São Paulo, Brazil, **4** Discipline of Evidence-Based Medicine, Paulista School of Medicine-Federal University of São Paulo (EPM-UNIFESP), São Paulo, Brazil, **5** Department of Physiotherapy, Universidade do Oeste Paulista (UNOESTE), Presidente Prudente, São Paulo State, Brazil, **6** Pelvic Care Center Maastricht, Maastricht University Medical Center, Maastricht, The Netherlands, **7** Department of Nursing, Botucatu Medical School (FMB), São Paulo State University (UNESP), Botucatu, São Paulo State, Brazil

☯ These authors contributed equally to this work.

‡ AMPB and EMAE are first authors on this work. SAML and MVCR are last authors on this work.

¶ Membership of The Diamater Study Group is listed in the Acknowledgments.

* angelicapascon@gmail.com



This is a Registered Report and may have an associated publication; please check the article page on the journal site for any related articles.

OPEN ACCESS

Citation: Barbosa AMP, Enriquez EMA, Rodrigues MRK, Prudencio CB, Atallah ÁN, Reyes DRA, et al. (2020) Effectiveness of the pelvic floor muscle training on muscular dysfunction and pregnancy specific urinary incontinence in pregnant women with gestational diabetes mellitus: A systematic review protocol. PLoS ONE 15(12): e0241962. <https://doi.org/10.1371/journal.pone.0241962>

Editor: Frank T. Spradley, University of Mississippi Medical Center, UNITED STATES

Received: April 20, 2020

Accepted: October 9, 2020

Published: December 7, 2020

Peer Review History: PLOS recognizes the benefits of transparency in the peer review process; therefore, we enable the publication of all of the content of peer review and author responses alongside final, published articles. The editorial history of this article is available here: <https://doi.org/10.1371/journal.pone.0241962>

Copyright: © 2020 Barbosa et al. This is an open access article distributed under the terms of the [Creative Commons Attribution License](https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and

Abstract

Background

There is ample evidence that gestational diabetes mellitus has a direct influence on urinary incontinence and pelvic floor muscles. There are no standardized pelvic floor muscle exercise programs in the literature for the physiotherapy and differ in the type of exercise, intensity, type and duration of application, and the frequency and duration of treatment sessions. The aim of this systematic review will be to investigate that Pelvic Floor Muscle Training can prevent and/or decrease the pregnancy specific urinary incontinence in women with gestational diabetes mellitus or gestational hyperglycemia.

Methods

We will perform a systematic review according to the Cochrane methodology of Randomized Controlled Trials. An overall search strategy will be developed and adapted for Embase, MEDLINE, LILACS, and CENTRAL databases, with the date of consultation until



Contents lists available at ScienceDirect

Journal of Bodywork & Movement Therapies

journal homepage: www.elsevier.com/jbmt

Prevention and Rehabilitation

Efficacy of the Pilates versus general exercises versus educational workshops on neuromuscular parameters: A randomized controlled trial

Beatriz Mendes Tozim^{a,*}, Guilherme Thomaz de Aquino Nava^b,
Ana Elisa Zuliani Stroppa Marques^a, Marcelo Tavella Navega^{a,b}^a Faculty of Philosophy and Sciences, São Paulo State University (UNESP), Marília, São Paulo, Brazil^b Department of Physical Education, Institute of Biosciences, São Paulo State University (UNESP), Rio Claro, São Paulo, Brazil

ARTICLE INFO

Article history:

Received 16 September 2019

Received in revised form

30 June 2020

Accepted 28 August 2020

Keywords:

Aging

Physical therapy specialty

Low back pain

Range of motion

Articular

Exercise movement techniques

Electromyography

ABSTRACT

Introduction: Muscle strength, flexibility and changes in muscle recruitment patterns are usually associated to low back pain (LBP). Physical exercises can reverse the adverse changes associated to LBP.**Objectives:** Compare Pilates, general exercises and educational workshop on muscle flexibility, strength and recruitment of the trunk extensor muscles in women with LBP.**Methods:** Forty-six women were randomly divided into Pilates group (PG, n = 16), general exercise group (GEG, n = 15), and educational group (EG, n = 15). This study sought to determine flexibility, muscle strength, and muscle recruitment of right (RIL), left (LIL) iliocostalis lumbar; right (RMU) and left (LMU) lumbar multifidus muscles. Both PG and GEG performed 16 exercise sessions, while EG attended 4 workshops. Statistical analysis used data sample from Shapiro-Wilk test, Pearson's correlation, multivariate analysis, mixed variance analysis, and Cohen's index.**Results:** Flexibility showed no differences ($p > 0.05$). Muscle strength increased in the intragroup analysis for PG ($p = 0.003$) and GEG ($p = 0.002$); however, the intergroup analysis presented no difference. Intergroup showed statistically significant differences for the recruitment of RMU in PG ($p < 0.001$). Intragroup analysis presented differences after interventions in PG for RIL ($p = 0.001$); in GEG for LIL ($p = 0.005$); and in EG for RIL ($p = 0.007$), LIL ($p = 0.002$) and RMU ($p < 0.001$).**Conclusions:** None of the groups showed flexibility improvements. PG and GEG increased muscle strength through intragroup analysis. Intergroup analysis showed an increase in recruitment of the RMU muscle in PG and all groups demonstrated significant improvements in the intragroup analysis.

© 2020 Elsevier Ltd. All rights reserved.

1. Introduction

The number of people at advanced ages is increasing worldwide (Choi et al., 2016). Ageing process involves an interaction between physical, physiological, and social factors; therefore, it may rise the occurrence of chronic diseases (Guimarães et al., 2014), such as low back pain (LBP) (Dellaroza et al., 2013; Hulla et al., 2016). There are known some neuromuscular alterations in adults with chronic LBP, such as increased intramuscular fat and decreased muscle mass of the erector spinae muscles (Sions et al., 2017). Furthermore, many

subjects have presented a decrease in muscle strength (Ishak et al., 2016) and a lower recruitment of the lumbar extensor muscles (Sions et al., 2017). Overall, low back pain is a protective mechanism for the spine (Kienbacher et al., 2017).

Studies showed that patients with LBP have less flexibility (Gordon and Bloxham, 2016; Ramírez and Lemus, 2010); therefore, reducing their ability to perform daily life activities (Felicio et al., 2017; Gordon and Bloxham, 2016), due to an increase in lumbar spine overload changes that are commonly related to shortened hamstring muscles and lumbopelvic rhythm (Gordon and Bloxham, 2016; Ramírez and Lemus, 2010).

Flexibility, stiffness and muscles recruitment pattern impairments affect spinal stability; therefore, physical exercise training plays an important part in the rehabilitation programs (Engers et al., 2016; Gordon and Bloxham, 2016; Guimarães et al., 2014;

* Corresponding author. São Paulo State University, Department of Physiotherapy and Occupational Therapy, Campus of Marília, 737 Hygino Muzzi Filho Avenue, Mirante, 17.525-000, Marília, State of São Paulo.

E-mail address: beatriztozim@yahoo.com.br (B. Mendes Tozim).



OPEN ACCESS

EDITED BY

Eric Siegel,
University of Arkansas for Medical
Sciences, United States

REVIEWED BY

Luis Mercado,
University of Arkansas for Medical
Sciences, United States
Diana Escalona-Vargas,
University of Arkansas for Medical
Sciences, United States

*CORRESPONDENCE

Angélica Mércia Pascon Barbosa
angelicapascon@gmail.com

[†]These authors share first authorship

[‡]These authors share last authorship

[§]These authors have contributed
equally to this work

SPECIALTY SECTION

This article was submitted to
Clinical Diabetes,
a section of the journal
Frontiers in Endocrinology

RECEIVED 01 June 2022

ACCEPTED 31 August 2022

PUBLISHED 06 October 2022

CITATION

Prudencio CB, Nunes SK, Pinheiro FA,
Sartório Filho CI, Nava GTA,
Salomoni SE, Pedroni CR, Rudge MVC,
Barbosa AMP and Diamater Study
Group (2022) Gestational diabetes is
associated with alteration on pelvic
floor muscle activation pattern during
pregnancy and postpartum:
Prospective cohort using
electromyography assessment.
Front. Endocrinol. 13:958909.
doi: 10.3389/fendo.2022.958909

Gestational diabetes is associated with alteration on pelvic floor muscle activation pattern during pregnancy and postpartum: Prospective cohort using electromyography assessment

Caroline Baldini Prudencio^{1†}, Sthefanie Kenickel Nunes^{1†},
Fabiane Affonso Pinheiro^{1§}, Carlos Izaías Sartório Filho^{1§},
Guilherme Thomaz de Aquino Nava^{2§},
Sauro Emerick Salomoni³, Cristiane Rodrigues Pedroni^{4§},
Marilza Vieira Cunha Rudge^{1‡}, Angélica Mércia Pascon Barbosa^{1,4**}
and Diamater Study Group

¹São Paulo State University (Unesp), Postgraduate Program on Tocogynecology, Botucatu Medical School, Botucatu, Brazil, ²Human Development and Technologies, Institute of Biosciences, São Paulo State University (UNESP), Rio Claro, Brazil, ³Independent Researcher, Hobart, TAS, Australia,

⁴São Paulo State University (Unesp), School of Philosophy and Sciences, Marília, Brazil

Background and objective: Gestational diabetes mellitus (GDM) is a comorbidity which may cause acute and lifelong disorders to mother and child. Alterations in muscular and connective tissues have been associated with GDM in translation studies, characterizing gestational diabetic myopathy. Pregnancy-specific urinary incontinence and sexual disabilities, disorders that depend on the pelvic floor muscle (PFM) integrity, are also associated with GDM both during and after pregnancy. The aim was to compare PFM activation patterns between GDM and non-GDM women from 24–30 gestational weeks to 18–24 months postpartum during a standard clinical test during gestation and postpartum.

Methods: We conducted a prospective three-time-point cohort study from gestation (24–30 weeks—T1, and 36–38 weeks—T2) to 18–24 months postpartum (T3). PFM electromyography was recorded in primigravida or primiparous women with one previous elective c-section with or without the diagnosis of GDM according to the American Diabetes Association criteria. A careful explanation of the muscle anatomy and functionality of the PFM was given to participants before EMG assessment. The outcome measures were PFM activation patterns assessed during pregnancy and postpartum, comparing intra and between groups. PFM activation patterns were assessed

Influence of pain in strength, resistance and recruitment of trunk muscles

Influência da dor na força, resistência e recrutamento dos músculos do tronco

Guilherme Thomaz de Aquino Nava¹, Beatriz Mendes Tozim², Mary Hellen Morcelli², Marcelo Tavella Navega²

DOI 10.5935/2595-0118.20180059

ABSTRACT

BACKGROUND AND OBJECTIVES: Changes in motor control may contribute to muscle recruitment deficits. The objective of this study was to evaluate strength, resistance, and recruitment of the trunk muscles.

METHODS: We evaluated 35 women, divided into two groups: chronic low back pain (LBPG, n=20) and control (CG, n=15). The clinical conditions, incapacity, level of pain, strength, resistance and the muscles recruitment: internal oblique (IO) and external oblique (EO), rectus abdominis (RA), lumbar iliocostal (LI) and lumbar multifidus (LM) were evaluated. MANOVA, MANCOVA and Kruskal-Wallis were used.

RESULTS: There was no significant difference between groups in the muscle strength test ($p < 0.172$). The control group showed the greater capacity for muscle resistance in the muscle endurance test ($p < 0.001$). In muscle recruitment, chronic low back pain group presented greater muscle activation, which was evident in the global stabilizing muscles EO and RA ($p < 0.05$).

CONCLUSION: Women with back pain had decreased muscular resistance and greater recruitment of the global muscles when compared to women with no back pain.

Keywords: Electromyography, Lumbar pain, Muscle strength, Physical resistance.

RESUMO

JUSTIFICATIVA E OBJETIVOS: Alterações no controle motor podem contribuir para déficits no recrutamento muscular. Sendo assim o objetivo deste estudo foi avaliar a força, resistência e o recrutamento dos músculos do tronco.

MÉTODOS: Foram avaliadas 35 mulheres, divididas em dois grupos: dor lombar crônica (GDL, n=20) e controle (GC, n=15). Avaliou-se as condições clínicas, incapacidade, nível da

dor, força, resistência e recrutamento dos músculos: oblíquo externo (OE) e interno (OI), reto abdominal (RA), iliocostal lombar (ICL) e multifido lombar (MUL). Utilizou-se MANOVA, MANCOVA e Kruskal-Wallis.

RESULTADOS: No teste de força muscular não houve diferença significativa entre os grupos ($p = 0,172$). O grupo controle demonstrou maior capacidade de resistência no teste de resistência muscular ($p < 0,001$). No recrutamento muscular, o grupo dor lombar crônica apresentou ativação muscular maior, que ficou evidente nos músculos estabilizadores globais, OE e RA ($p < 0,05$).

CONCLUSÃO: Mulheres com dor lombar apresentaram resistência muscular diminuída e maior recrutamento nos músculos globais, quando comparadas às mulheres sem dor lombar.

Descritores: Dor lombar, Eletromiografia, Força muscular, Resistência física.

INTRODUÇÃO

A dor lombar (DL) é definida como dor ou desconforto que pode acometer a região da coluna lombar, lombossacral ou sacroilíaca e se manifesta como umas das principais disfunções musculoesqueléticas da atualidade¹⁻³. Aproximadamente 80% da população sofrerá algum episódio de DL durante a vida, e dentre estes, aproximadamente 62% apresentarão recorrência após um ano²⁻⁶. A etiologia da dor lombar crônica (DLC) e seu curso natural são questões importantes que ainda não são bem compreendidas, sendo que aproximadamente 90% dos casos de DLC não apresentam etiologia definida ou identificável, dificultando o tratamento^{1,5}. Estudos foram feitos com o intuito de avaliar a relação entre a força e a resistência dos músculos extensores do tronco e a DLC, que é um fenômeno relacionado com a incapacidade a longo prazo^{1,6}.

Uma das hipóteses para a alteração na força e resistência muscular são as alterações na adaptação neural e consequente modificação no controle motor^{7,8}. Essa teoria sugere que alterações em diferentes níveis do sistema nervoso podem resultar na redistribuição da atividade muscular e mudança no comportamento mecânico, que pode levar a déficits no controle postural dos músculos do tronco^{6,8,9}. Contudo, essa relação entre força, resistência e recrutamento muscular dos músculos estabilizadores do tronco foi pouco abordada. Dessa forma, nota-se a importância da avaliação do recrutamento dos músculos do tronco simultaneamente à avaliação dos parâmetros de força e resistência muscular. Sendo assim, para a avaliação do sistema muscular é importante dividi-lo em músculos locais e globais devido às suas funções^{8,10}.

A literatura descreve a eletromiografia de superfície como instrumento que apresenta características que permite avaliar a função dos músculos do tronco de indivíduos saudáveis e com lesão^{5,11,12}.

1. Universidade Estadual Paulista, Instituto de Biociências, Departamento de Educação Física, Rio Claro, SP, Brasil.

2. Universidade Estadual Paulista, Faculdade de Filosofia e Ciências, Departamento de Fisioterapia e Terapia Ocupacional, Marília, SP, Brasil.

Apresentado em 11 de março de 2018.

Aceito para publicação em 20 de agosto de 2018.

Conflito de interesses: não há – Fontes de fomento: não há.

Endereço para correspondência:

Av. Hygino Muzzi Filho, 737 – Mirante

17525-000 Marília, SP, Brasil.

E-mail: gtnava@gmail.com



Contents lists available at ScienceDirect

Journal of Biomechanics

journal homepage: www.elsevier.com/locate/jbiomech
www.JBiomech.com

Influence of transducer orientation on shear wave velocity measurements of the iliotibial band

Manuela Besomi^a, Guilherme Thomaz de Aquino Nava^b, Wolbert van den Hoorn^a, François Hug^{a,c,d}, Bill Vicenzino^a, Paul W. Hodges^{a,*}^a The University of Queensland, School of Health and Rehabilitation Sciences, Brisbane, Qld 4072, Australia^b Department of Physical Education, Institute of Biosciences of Rio Claro, São Paulo State University (UNESP), Rio Claro, São Paulo, Brazil^c Faculty of Sport Sciences, Laboratory "Movement, Interactions, Performance" (EA 4334), University of Nantes, Nantes, France^d Institut Universitaire de France (IUF), Paris, France

ARTICLE INFO

Article history:

Accepted 22 February 2021

Keywords:

Shear wave elastography
Iliotibial band
Anisotropy
Stiffness

ABSTRACT

Tissue anisotropy influences estimation of mechanical properties of connective tissues, such as the iliotibial band (ITB). This study investigated the influence of ultrasound transducer rotation and tilt on shear wave velocity (SWV, an index of stiffness) measurements of the ITB and the intra-rater repeatability of SWV measurements in the longitudinal direction.

SWV was measured unilaterally (dominant limb) using ultrasound shear wave elastography in the middle region of the ITB in supine at rest (20–25° knee flexion) in ten healthy volunteers (4 females). A 3-dimensional video system provided real-time feedback of probe orientation with respect to the thigh. Measurements were made at 10° increments of probe rotation, from longitudinal to transverse alignment relative to the approximate direction of ITB fibres, and 5–10° tilts about the longitudinal and sideways axes of the transducer. One-way repeated measures ANOVA compared SWV between angles and tilts. Intraclass correlation coefficients (ICCs) and standard error of measurement (SEM) were used to calculate repeatability for two to five (longitudinal only) repetitions.

SWV was greatest when the transducer was aligned to ITB fibres (longitudinal: 10.5 ± 1.7 m/s) and lowest when perpendicular (transverse: 5.8 ± 2.4 m/s). Compared to longitudinal alignment, SWV decreased significantly ($p < 0.01$) when the transducer was rotated 20° or more. Tilted measurements did not differ between angles. Intra-rater repeatability was excellent with the average of two measurements (ICC = 0.99, 95% CI 0.95, 0.99; SEM = 0.31 m/s).

These findings show that SWV changes with orientation relative to fibre direction. Transducer orientation requires careful control to ensure comparable measures.

© 2021 Elsevier Ltd. All rights reserved.

1. Introduction

Shear wave velocity (SWV) can be used to estimate the mechanical properties of biological tissues using shear wave elastography (SWE) (Creze et al., 2018; Taljanovic et al., 2017). This method is influenced by the anisotropy of the tissue, which refers to the dependence on the direction of the tissue fibres relative to the plane of measurement (Gennisson et al., 2013). Anisotropy is problematic for estimates made with sonographic techniques *ex-vivo* (Hoffmeister et al., 1996) and *in-vivo* (Gennisson et al., 2010), and it is generally recommended to align the ultrasound trans-

ducer with direction of the tissue of interest (e.g., muscle fibres or collagen fibres in tendon) (Gennisson et al., 2013). This is likely to be more challenging in complex structures such as the iliotibial band (ITB). The ITB is a fibrous band of connective tissue that runs longitudinally along the lateral aspect of the thigh and represents the thickening or reinforced part of the deep fascia lata (Birnbbaum et al., 2004; Flato et al., 2017; Stecco et al., 2013). The structure of the ITB is complex because fascial structures that originate from the knee, thigh, and hip converge into the ITB from different directions (Fairclough et al., 2006). The mechanical properties of the ITB have been investigated for its application in surgical procedures, such as ligament reconstruction (Hammer et al., 2012; Noyes et al., 1984), but is also commonly highlighted as a potential contributor to painful conditions of the lower limb (Charles and Rodgers, 2020). The relevance of its function and

* Corresponding author at: School of Health and Rehabilitation Sciences, The University of Queensland, Brisbane, Qld 4072, Australia.

E-mail address: p.hodges@uq.edu.au (P.W. Hodges).



Is there a correlation between a 20-min pad-test and subjective urine leakage amount?

Caroline Baldini Prudencio¹ · Letícia de Azevedo Ferreira² · Márcia Maria Gimenez² ·
 Guilherme Thomaz de Aquino Nava³ · Maria Augusta Tezelli Bortolini² · Rodrigo Aquino Castro² · Fátima Faní Fitz²

Received: 18 May 2021 / Accepted: 18 July 2021
 © The International Urogynecological Association 2021

Abstract

Introduction and hypothesis The quantification of urinary incontinence (UI) is widely used in clinical practice to guide the prognosis and treatment, and the pad test is an inexpensive, quick, and easy tool to assess UI that has been used in studies in the literature. Another way to evaluate UI is the subjective urine leakage amount, but no studies have tried to correlate it with the 20-min pad test. Therefore, this study aimed to assess the correlation of the 20-min pad test with the subjective urine leakage amount and compare it with the pelvic floor function.

Methods This is a cross-sectional study with a sample size of 72 participants. It evaluated pelvic floor muscle strength as well as the duration of symptoms and pad weight. It used mean, standard deviation, median, and 95% confidence interval. In addition, ANOVA, Kruskal-Wallis, and Spearman's correlation coefficient were used. The significance level was fixed at 5% (significant if $P < 0.05$).

Results Only age was different between leakage volumes; participants who report greater UI volume were older than the participants who leaked less urine. There were no differences related to the duration of symptoms between different UI volumes and pad weights according to the subjective volume reported. Spearman's coefficient between pad weight and subjective volume of urine leakage was $r_s = 0.558$ ($P \leq 0.0001$), demonstrating a moderate positive correlation.

Conclusions There was a moderate correlation between the UI volume reported and the 20-min pad test. Additionally, no differences related to pelvic floor function were detected.

Keywords Female · Incontinence pads · Subjective · Urinary incontinence

Introduction

The quantification of urinary incontinence (UI) is widely used in clinical practice to guide prognosis and treatment, avoiding inappropriate and unnecessary interventions [1, 2]. Objective and subjective assessment methods are employed. The literature has shown that less complex

diagnostic methods such as validated symptom scales and pad tests are cheaper, more comfortable, and sufficient to provide a correct diagnosis [3]. In addition, a Cochrane review reported that when complex methods such as urodynamics are applied, the clinical decision changes, but it is not clear whether it contributes to enhancing clinical outcomes [4].

Pad test was introduced in the 1980s, and since then different protocols have been published [5]. The selection of an inexpensive, quick, and easy tool to perform assessment significantly influences clinical practice adherence [6]. The International Continence Society recommends using the 24- or 1-h pad test because of the reproductivity and reliability [7], but a 20-min pad test protocol has been used [8] and compared to the 1-h pad test showed better sensitivity [6] and reproducibility [9] for stress urinary incontinence (SUI). However, reliability was not measured.

✉ Caroline Baldini Prudencio
caroline_baldini@hotmail.com

¹ Department of Tocogynecology, Botucatu Medical School, São Paulo State University (UNESP), São Paulo, Botucatu, Brazil

² Department of Gynecology, Federal University of São Paulo (UNIFESP), São Paulo, Brazil

³ Department of Physical Education, Institute of Biosciences of Rio Claro, São Paulo State University (UNESP), Rio Claro, São Paulo, Brazil

Knowledge of pelvic floor disorders in young women: a cross-sectional study

Conhecimento dos distúrbios do assoalho pélvico em mulheres jovens: um estudo transversal

Caroline Baldini Prudencio ¹

Guilherme Thomaz de Aquino Nava ²

Bruna Rosa de Souza ³

Aline Medolago Carr ¹

Raissa Escandiusi Avramidis ¹

Angélica Mércia Pascon Barbosa ^{1,3*}

¹ Universidade Estadual Paulista (UNESP), Botucatu, SP, Brazil

² Universidade Estadual Paulista (UNESP), Rio Claro, SP, Brazil

³ Universidade Estadual Paulista (UNESP), Marília, SP, Brazil

Date of first submission: July 20, 2021

Last received: October 15, 2021

Accepted: January 14, 2022

Associate editor: Maria Augusta Heim

* **Correspondence:** angelicapascon@gmail.com

Abstract

Introduction: Young women's knowledge about pelvic floor function and dysfunction are poor. **Objective:** To identify the level of knowledge of young women about pelvic floor muscles (PFM) anatomy and function, pelvic floor muscle dysfunction (PFMD), pelvic organ prolapse (POP), and sexual dysfunction (SD). **Methods:** This is a cross-sectional study. Two hundred forty-two (242) young women from first to the third year of high school from ten public schools, in geographically disparate areas of a Brazilian county serving economic minority student populations, participated in the study. Data analysis was performed using SPSS 20.0 (SPSS Inc., Chicago, IL). The categorical data were expressed as absolute and relative frequency. **Results:** Only 28% of the young women knew PFM, and 26% answered to be able to contract these muscles. The prevalence of urinary incontinence was 16%, while 5% reported fecal incontinence. The previous knowledge about POP was similar between bladder and uterus prolapse, 34% and 40%, respectively. SD was known by 48% of the young women. Seventy-seven young women (31.8%) declared to have had sexual intercourse. Ten percent declared difficulties to allow vaginal penetration, and 48% of those who were able to have penetration declared that they experienced pain and discomfort. **Conclusion:** Young women have little knowledge about the PFM anatomy and function, PFMD, POP, and SD. In addition, they have complaints related to sexual practice, such as difficulty during vaginal penetration and pain.

Keywords: Adolescent. Health education. Pelvic floor disorders. Primary prevention. Women's health.

STUDY PROTOCOL

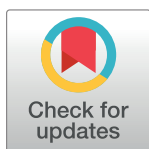
Motor control exercises versus general exercises for greater trochanteric pain syndrome: A protocol of a randomized controlled trial

Guilherme Thomaz de Aquino Nava^{1☯*}, Caroline Baldini Prudencio^{2☯}, Rafael Krasic Alaiti^{3☯}, Beatriz Mendes Tozim^{4☯}, Rebecca Mellor^{5☯}, Cristiane Rodrigues Pedroni^{1,4☯}, Angélica Mércia Pascon Barbosa^{2,4☯}, Marcelo Tavella Navega^{1,4☯}

1 Department of Physical Education, Institute of Biosciences, São Paulo State University (UNESP), Rio Claro, São Paulo, Brazil, **2** Department of Gynecology and Obstetrics, Botucatu Medical School, São Paulo State University (UNESP), Botucatu, São Paulo, Brazil, **3** Nucleus of Neuroscience and Behavior and Nucleus of Applied Neuroscience, Universidade de São Paulo (USP), São Paulo, Brazil, **4** Department of Physiotherapy and Occupational Therapy, Faculty of Philosophy and Sciences, São Paulo State University (UNESP), Marília, São Paulo, Brazil, **5** School of Health and Rehabilitation Sciences, The University of Queensland, Brisbane, Queensland, Australia

☯ These authors contributed equally to this work.

* gtanava@gmail.com



OPEN ACCESS

Citation: Thomaz de Aquino Nava G, Baldini Prudencio C, Krasic Alaiti R, Mendes Tozim B, Mellor R, Rodrigues Pedroni C, et al. (2022) Motor control exercises versus general exercises for greater trochanteric pain syndrome: A protocol of a randomized controlled trial. PLoS ONE 17(6): e0269230. <https://doi.org/10.1371/journal.pone.0269230>

Editor: George Vousden, Public Library of Science, UNITED KINGDOM

Received: July 19, 2021

Accepted: May 12, 2022

Published: June 24, 2022

Peer Review History: PLOS recognizes the benefits of transparency in the peer review process; therefore, we enable the publication of all of the content of peer review and author responses alongside final, published articles. The editorial history of this article is available here: <https://doi.org/10.1371/journal.pone.0269230>

Copyright: © 2022 Thomaz de Aquino Nava et al. This is an open access article distributed under the terms of the [Creative Commons Attribution License](https://creativecommons.org/licenses/by/4.0/), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Abstract

Introduction

Greater trochanteric pain syndrome is an overarching term used to define pain and tenderness in the greater trochanteric region of the femur, which is more common in women. Abnormal control of lower limb movements and deficient neuromuscular parameters may lead to greater trochanteric pain syndrome; however, no studies have used neuromuscular training as a treatment strategy. Thus, this study aims to compare the effect of a protocol of general exercises versus a program of motor control training on pain at baseline and after treatment in women with greater trochanteric pain syndrome.

Methods

The study was approved by the Research Ethics Committee (CAAE: 87372318.1.0000.5406) and has been prospectively registered on the Brazilian Registry of Clinical Trials (RBR-37gw2x). Sixty participants will be randomized to receive motor control exercises or general exercises. The application will be performed twice a week for 8 weeks. The participants will be evaluated before the treatment (T0), after 8 weeks of intervention (T8) and after 60 weeks of intervention (T60). The primary outcome measures will be the hip pain intensity, and secondary outcomes will be muscle strength, kinesiophobia, global perceived effect, pain catastrophization, central sensitization and quality of life.



Muscle recruitment and co-contraction when walking in young women with chronic lumbar pain

Recrutamento e cocontração muscular durante a marcha em mulheres jovens com dor lombar crônica

Reclutamiento y co-contracción muscular durante la marcha en mujeres jóvenes con dolor lombar crónica

Beatriz Mendes Tozim ^[a], Guilherme Thomaz de Aquino Nava ^[b],
Ana Elisa Zuliani Stroppa Marques ^[a], Nise Ribeiro Marques ^[b], Mary Hellen Morcelli ^[c],
Marcelo Tavella Navega ^[a, c]*

^[a] Universidade Estadual Paulista (Unesp), Marília, SP, Brazil

^[b] Universidade Sagrado Coração (USC), Bauru, SP, Brazil

^[c] Universidade Estadual Paulista (Unesp), Rio Claro, SP, Brazil

Abstract

Introduction: The lumbar pain is the main musculoskeletal complaint reported by the active population, and it prevents daily activities such as walking. **Objective:** To assess muscle recruitment and the co-contraction of the trunk muscles during different walking speed in individuals with and without chronic lumbar pain. **Method:** Thirty-four sedentary young women attended the study, in which 18 belonged to the lumbar pain team (LPT) and 16 to the team without lumbar pain (WLP). We assessed the electromyography activity of the internal oblique (IO) local muscle and lumbar multifidus (MUL), and global external oblique (EO), abdominal rectus (AR) and lumbar iliocostalis (LIC), during walking. The electromyography analysis was performed from the average of the

* BMT: PhD, e-mail: beatriztozim@yahoo.com.br
GTAN: Doctoral student, e-mail: gtnava@gmail.com
AEZSM: PhD, e-mail: anastropa@hotmail.com
NRM: PhD, e-mail: nisermarques@yahoo.com.br
MHM: PhD, e-mail: morcellimh@gmail.com
MTN: PhD, e-mail: navega@marilia.unesp.br

Pelvic floor muscle dysfunction at 3D transperineal ultrasound in maternal exposure to gestational diabetes mellitus: A prospective cohort study during pregnancy

Fabiane A. Pinheiro¹ | Carlos I. Sartorão Filho^{1,2}  | Caroline B. Prudencio¹  |
 Sthefanie K. Nunes¹  | Tawana Pascon¹ | Ragavendra L. S. Hallur^{1,3} |
 Luis Takano^{1,2} | Eusébio M. A. Enriquez¹ | Bruna B. Catinelli¹ |
 Aline M. Carr¹ | Baerbel Junginger⁴  | Marilza V. C. Rudge¹  |
 Angélica M. P. Barbosa^{1,5}  | **The Diamater Study Group**

¹Postgraduate Program on Tocogynecology, Botucatu Medical School (FMB), São Paulo State University (UNESP), Botucatu, São Paulo State, Brazil

²Department of Medical Health, Medical School, Fundação Educacional do Município de Assis (FEMA, Assis Municipality Educational Foundation (FEMA), Assis, São Paulo State, Brazil

³Center for Biotechnology, Pravara Institute of Medical Sciences (Deemed to be University), Loni, Maharashtra, India

⁴Department of Gynecology, Pelvic Floor Center Charité, Charité University Hospital, Berlin, Germany

⁵Department of Physiotherapy and Occupational Therapy, School of Philosophy and Sciences, São Paulo State University (UNESP), Marília, São Paulo State, Brazil

Correspondence

Angélica M. P. Barbosa, PT, PhD,
 Department of Physiotherapy and
 Occupational Therapy, School of
 Philosophy and Sciences, São Paulo State
 University (UNESP), Marília, SP, Brazil.
 Email: angelicapascon@gmail.com

Funding information

Fundação de Amparo à Pesquisa do
 Estado de São Paulo,
 Grant/Award Numbers: FAPESP-2016/
 01743-5, 2021/10665-6

Abstract

Aim: This study aimed to assess, for the first time, the dynamic morphometry of pelvic floor muscles (PFM) using three-dimensional transperineal ultrasound (3D-TPUS) and its progression at two-time points of gestation between women with and without gestational diabetes mellitus (GDM), and whether the PFM dysfunction is connected to GDM.

Methods: The study comprised 83 consecutive pregnant women with ($n = 38$) and without ($n = 45$) GDM screened at 24–30 and 38–40 weeks of gestation. 3D-TPUS and a mobility test were used to quantify PFM dynamic morphometry during maximum contraction and the Valsalva maneuver.

Results: When compared to the control group, GDM women had no significant variations in all levator hiatal dimensions at 24–30 weeks of gestation. Meanwhile, women with GDM experienced an increase in levator hiatal area (LHa) ($p < 0.000$) during PFM contraction and enlargement in LHa ($p < 0.001$) during Valsalva maneuver ($p = 0.010$) at 38–40 weeks of gestation.

Fabiane A. Pinheiro, Carlos I. Sartorão Filho, Marilza V. C. Rudge, and Angélica M. P. Barbosa contributed equally to this study.

Fabiane A. Pinheiro and Carlos I. Sartorão Filho are co-first authors.

Caroline B. Prudencio, Sthefanie K. Nunes, Tawana Pascon, Ragavendra L. S. Hallur, Luis Takano, Eusébio M. A. Enriquez, Bruna B. Catinelli, Aline M. Carr, and Baerbel Junginger contributed equally to this study.

Marilza V. C. Rudge and Angélica M. P. Barbosa are last authors of this study.



Contents lists available at ScienceDirect

Journal of Bodywork & Movement Therapies

journal homepage: www.elsevier.com/jbmt

Prevention and Rehabilitation

Pelvic floor muscle training and postural balance in elderly women: An exploratory single arm trial



Gianluca Loyolla Montanari Leme ^a, Caroline Baldini Prudencio ^b,
 Guilherme Thomaz de Aquino Nava ^a, Angélica Mércia Pascon Barbosa ^{b, c},
 Marcos Eduardo Scheicher ^{a, c, *}

^a Human Development and Technologies Program, Institute of Biosciences, São Paulo State University (UNESP), Rio Claro, São Paulo, Brazil

^b Department of Tocogynecology, Botucatu Medical School (FMB), São Paulo State University (UNESP), São Paulo, Brazil

^c Department of Physiotherapy and Occupational Therapy, Faculty of Philosophy and Sciences, São Paulo State University (UNESP), Marília, São Paulo, Brazil

ARTICLE INFO

Article history:

Received 4 February 2021

Received in revised form

12 July 2021

Accepted 24 September 2021

Keywords:

Aging

Pelvic floor

Postural balance

Rehabilitation

ABSTRACT

Introduction: To investigate the influence of a training of mobility, gait speed and postural balance of pelvic floor muscles (PFM).

Methods: A single-arm clinical trial study was approved and registered at the Brazilian Clinical Trials Registry (RBR-4rxhd4). Eighteen women over the age of 60 with pelvic floor dysfunction complaints were subjected to 10 sessions of functional electrical stimulation and digital palpation of PFM. Mobility and gait speed were evaluated by the Timed up and Go and the 10-m walk tests respectively. Standing balance was evaluated using a force plate.

Results: No significant differences were found in mobility, gait speed, and standing balance. PFM contraction worsened mobility, gait speed, and standing balance performance.

Conclusions: The training protocol enhanced PFM strength and endurance, but the improved ability to recruit PFM did not positively affect balance, mobility, and gait speed.

© 2021 Published by Elsevier Ltd.

1. INTRODUCTION

The sensory inputs involved in posture control and balance include visual and vestibular inputs, as well as somatosensory input (Massion, 1994; Ragnarsdóttir, 1996). The somatosensory system is a complex system of many interactions that complies anticipatory and adaptive mechanisms, besides neuromuscular synergies in motor unit recruitment strategies and muscle activation patterns; therefore, the action of PFM are known to assist in controlling continence and postural balance (Imbiriba et al., 2020; Kharaji et al., 2019; Sapsford et al., 2008). PFM are part of the trunk stability mechanism with the transversus abdominis, diaphragm, multifidus muscles that help to stabilize the pelvis and spine, as well as helping more efficiently in keeping the extremities during functional and postural activities (Sapsford, 2004; Vesentini et al., 2019). Aging has been known as a condition related to declining

mobility and gait speed. There is also an increase in risk factors to falling and the appearance of disabilities, which may affect functional independence and quality of life of the elderly. There is a significant correlation between balance, mobility, and gait speed, although their deterioration is a strong predictor of mortality, hospitalization, and disability, besides requiring more resources in nursing facilities (Cruz-Jimenez, 2017).

Regarding to the functional behavior, PFM strength is the mainly pattern presented, but other functional components are just recently considered relevant to pelvic floor dysfunction (PFD), such as endurance and timing (Smith et al., 2007a; Vieira et al., 2020). Evidence has shown decreased or delayed pelvic floor function in women with urinary incontinence (UI) (Moser et al., 2018). In addition, women with UI had a worse overall standing balance than continent woman (Chmielewska et al., 2017; Kim et al., 2010; Smith et al., 2008). The Older women with UI are significantly associated with fall risk (Schluter et al., 2020).

Studies have shown the relation of pelvic floor activity, and delayed, and reduced balance in patients with urinary incontinence (Smith et al., 2007b, 2008). Recent systematic reviews have demonstrated the effects of pelvic floor training on symptoms of UI

* Corresponding author. Hygino Muzzi Filho Avenue 737, 17.525-900, Marília, São Paulo, Brazil.

E-mail address: marcos.scheicher@unesp.br (M.E. Scheicher).

Prevalence and factors associated with pelvic floor dysfunction in university women: a cross-sectional study

Prevalência e fatores associados à disfunção do assoalho pélvico em mulheres universitárias: um estudo transversal

Luana Fávaro Iamundo ¹

Guilherme Thomaz de Aquino Nava ²

Paulo Roberto Rocha Júnior ³

Caroline Baldini Prudencio ⁴

Angélica Mércia Pascon Barbosa ^{1,4*}

¹ Universidade Estadual Paulista (UNESP), Marília, SP, Brazil

² Universidade Estadual Paulista (UNESP), Rio Claro, SP, Brazil

³ Centro Universitário de Adamantina (UNIFAI), Adamantina, SP, Brazil

⁴ Universidade Estadual Paulista (UNESP), Botucatu, SP, Brazil

Date of first submission: March 8, 2022

Last received: June 8, 2022

Accepted: July 27, 2022

Associate editor: Ana Paula Cunha Loureiro

* **Correspondence:** angelicapascon@gmail.com

Abstract

Introduction: Urinary incontinence (UI), fecal incontinence (FI), and genito-pelvic pain or penetration disorder (GPPPD) are considered pelvic floor dysfunction (PFD), and are mainly characterized by poor functionality of the pelvic floor muscles. Despite the relevance of these dysfunctions in women's lives, the demand for care is low.

Objective: To analyze the prevalence of PFD, in university women, and factors associated with PFD. **Methods:** This is a cross-sectional study conducted at São Paulo State University, Marília, SP, Brazil, with undergraduate and/or postgraduate women aged over 18 years. An online questionnaire containing 40 open and multiple-choice questions about PFD was developed by the authors and a Google form was disclosed via social media (Facebook, Instagram) to the participants. The questionnaire was applied between April and July 2020. **Results:** A sample of 707 participants was included. The average age was 22.5 ± 21.0 years old. The most prevalent PFD was GPPPD, reported by 30.7% of women, followed by UI (16.8%) and FI (3.2%). PFD was significantly less reported in the Midwest region compared to other regions ($p = 0.015$) and significantly more prevalent in women who attended public university ($p = 0.038$), in women with UI, FI, and GPPPD. The association-test showed that attending public university showed association to UI ($p < 0.001$), FI ($p = 0.008$) and GPPPD ($p = 0.006$). In addition, parity showed association with GPPD ($p = 0.032$) and to attend health courses with UI ($p = 0.002$). **Conclusion:** PFD is prevalent among university women and GPPPD was the most recurrent, followed by UI and FI. GPPPD was associated with parity and attending a public university. UI was associated with attending public university and health courses. FI was associated with attending a public university.

Keywords: Pelvic floor disorders. Physiological sexual dysfunction. Urinary incontinence. University.



Relaxin-2 during pregnancy according to glycemia, continence status, and pelvic floor muscle function

Caroline Baldini Prudencio¹ · Sthefanie Kenickel Nunes¹ · Fabiane Affonso Pinheiro¹ · Carlos Isaías Sartorão Filho¹ · Flávia Ignácio Antônio² · Guilherme Thomaz de Aquino Nava³ · Marilza Vieira Cunha Rudge¹ · Angélica Mércia Pascon Barbosa^{1,2} · Diamater Study Group

Received: 16 November 2021 / Accepted: 5 May 2022
 © The International Urogynecological Association 2022

Abstract

Introduction and hypothesis To investigate relaxin-2 concentration comparing gestational diabetes mellitus (GDM) and non-GDM patients during pregnancy according to urinary incontinence (UI) and pelvic function status.

Methods This is a cross-sectional study evaluating 282 pregnant women from 24 weeks of gestation. The participants were divided into two groups, non-GDM and GDM, according to American Diabetes Association's diabetes mellitus gestational threshold. In addition, according to subanalysis, both groups were subdivided according to the presence of pregnancy-specific urinary incontinence: non-GDM continent, non-GDM incontinent, GDM continent, and GDM incontinent. All participants filled in questionnaires on clinical, obstetric, and urinary continence status (International Consultation on Incontinence Questionnaire-Short Form, ICIQ-SF, and Incontinence Severity Index, ISI), followed by pelvic floor muscle evaluation by the PERFECT scheme in which strength, endurance, and speed of contractions were evaluated.

Results Serum relaxin-2 concentrations were significantly lower in pregnant women with pregnancy-specific urinary incontinence in both non-GDM and GDM patients, but GDM showed the lowest concentration. In addition, the stratification of the groups according to pelvic floor muscle strength showed that pregnant patients with GDM and modified Oxford scale 0–2 had significantly lower levels than those who were non-GDM and GDM with Modified Oxford Scale 3–5. Relaxin-2 level was much lower in GDM incontinent pregnant women with MOS 0–2 compared to the other three groups.

Conclusions Lower relaxin-2 concentration was associated with the presence of pregnancy-specific urinary incontinence, but the combination of GDM, pregnancy-specific urinary incontinence, and lower levels of pelvic floor strength led to lower levels of relaxin-2 compared to the other three groups.

Keywords Gestational diabetes · Obstetrics · Pelvic floor · Pregnancy · Relaxin-2

Introduction

Urinary incontinence (UI) is a silent but prevalent event [1]. Pregnancy-specific urinary incontinence (PSUI) is a term we propose to describe the urinary incontinence that appears during pregnancy. The pathophysiology is multifactorial, and many gaps in the literature have not yet been clarified, including the inclusion in a scientific glossary. The first-line treatment for UI is pelvic floor muscle (PFM) training [2]; therefore, PFM function is one of the main points of interest, and all other possible conditions that modify its function and/or morphology should be investigated. Gestational diabetes mellitus (GDM) can damage muscular tissue, causing atrophy, thinning, disorganization, and co-localization of fast

✉ Angélica Mércia Pascon Barbosa
angelicapascon@gmail.com

¹ Postgraduate Program on Tocogynecology, São Paulo State University (UNESP), São Paulo, Botucatu, Brazil

² School of Rehabilitation Sciences, Faculty of Health Sciences, University of Ottawa, Ottawa, ON, Canada

³ Department of Physical Education, Institute of Biosciences of Rio Claro, São Paulo State University (UNESP), São Paulo, Rio Claro, Brazil



OPEN

Reversal of diabetic-induced myopathy by swimming exercise in pregnant rats: a translational intervention study

Bruna B. Catinelli^{1,37}, Patrícia S. Rossignoli^{2,37}, Juliana F. Floriano¹, Aline M. Carr¹, Rafael G. de Oliveira¹, Nilton J. dos Santos^{3,4}, Lara C. C. Úbeda⁵, Maria Angélica Spadella⁶, Raghavendra L. S. Hallur^{1,7}, Luis Sobreira^{1,8,9,10,11}, Sérgio L. Felisbino³, Iracema M. P. Calderon¹, Angélica M. P. Barbosa^{1,2,38}, Marilza V. C. Rudge^{1,38}✉ & The Diamater Study Group^{1*}

Gestational diabetes mellitus (GDM) plus rectus abdominis muscle (RAM) myopathy predicts long-term urinary incontinence (UI). Atrophic and stiff RAM are characteristics of diabetes-induced myopathy (DiM) in pregnant rats. This study aimed to determine whether swimming exercise (SE) has a therapeutic effect in mild hyperglycemic pregnant rats model. We hypothesized that SE training might help to reverse RAM DiM. Mild hyperglycemic pregnant rats model was obtained by a unique subcutaneous injection of 100 mg/kg streptozotocin (diabetic group) or citrate buffer (non-diabetic group) on the first day of life in Wistar female newborns. At 90 days of life, the rats are mated and randomly allocated to remain sedentary or subjected to a SE protocol. The SE protocol started at gestational day 0 and consisted of 60 min/day for 6 days/week in a period of 20 days in a swim tunnel. On day 21, rats were sacrificed, and RAM was collected and studied by picrosirius red, immunohistochemistry, and transmission electron microscopy. The SE protocol increased the fiber area and diameter, and the slow-twitch and fast-twitch fiber area and diameter in the diabetic exercised group, a finding was also seen in control sedentary animals. There was a decreased type I collagen but not type III collagen area and showed a similar type I/type III ratio compared with the control sedentary group. In conclusion, SE during pregnancy reversed the RAM DiM in pregnant rats. These findings may be a potential protocol to consider in patients with RAM damage caused by GDM.

Gestational diabetes mellitus (GDM) is known as a serious global health problem¹. GDM can cause damage to the skeletal muscle and extracellular matrix (ECM) health and function, i.e. maternal hyperglycemic myopathy^{2–4}.

¹Postgraduate Program on Tocogynecology, Department of Gynecology and Obstetrics, Botucatu Medical School, São Paulo State University (UNESP), Botucatu, São Paulo, Brazil. ²Department of Physiotherapy and Occupational Therapy, School of Philosophy and Sciences, São Paulo State University (UNESP), Marília, São Paulo, Brazil. ³Laboratory of Extracellular Matrix Biology, Department of Structural and Functional Biology, Institute of Biosciences of Botucatu, São Paulo State University (UNESP), Botucatu, São Paulo, Brazil. ⁴Department of Structural and Functional Biology, Institute of Biology (IB), UNICAMP, University of Campinas (UNICAMP), Campinas, São Paulo, Brazil. ⁵University of Marília (UNIMAR), Marília, São Paulo, Brazil. ⁶Human Embryology Laboratory, Marília Medical School (FAMEMA), Marília, São Paulo, Brazil. ⁷Pravara Institute of Medical Sciences (Deemed to be University), Loni, Rahata Taluk, Ahmednagar District, Maharashtra 413736, India. ⁸Cellular and Molecular Physiology Laboratory (CMPL), Department of Obstetrics, Division of Obstetrics and Gynaecology, School of Medicine, Faculty of Medicine, Pontificia Universidad Católica de Chile, 8330024 Santiago, Chile. ⁹Department of Physiology, Faculty of Pharmacy, Universidad de Sevilla, 41012 Seville, Spain. ¹⁰University of Queensland Centre for Clinical Research (UQCCR), Faculty of Medicine and Biomedical Sciences, University of Queensland, Herston, QLD 4029, Australia. ¹¹Division of Pathology, Department of Pathology and Medical Biology, University of Groningen, University Medical Center Groningen (UMCG), 9713GZ Groningen, The Netherlands. ³⁷These authors contributed equally: Bruna B. Catinelli and Patrícia S. Rossignoli. ³⁸These authors jointly supervised this work: Angélica M. P. Barbosa and Marilza V. C. Rudge. ✉A list of authors and their affiliations appears at the end of the paper. ✉email: marilzarudge@gmail.com



Article

Transcriptomic Profiling of Rectus Abdominis Muscle in Women with Gestational Diabetes-Induced Myopathy: Characterization of Pathophysiology and Potential Muscle Biomarkers of Pregnancy-Specific Urinary Incontinence

Fernanda Cristina Bergamo Alves ¹, Rafael Guilen de Oliveira ¹, David Rafael Abreu Reyes ¹, Gabriela Azevedo Garcia ², Juliana Ferreira Floriano ¹, Raghavendra Hallur Lakshmana Shetty ^{1,3}, Edson Assunção Mareco ⁴, Maeli Dal-Pai-Silva ⁵, Spencer Luiz Marques Payão ⁶, Fátima Pereira de Souza ⁷, Steven S. Witkin ^{8,9}, Luis Sobrevia ^{1,10,11,12,13,14}, Angélica Mércia Pascon Barbosa ^{1,15,†}, Marilza Vieira Cunha Rudge ^{1,*,†} and Diamater Study Group [‡]



Citation: Alves, F.C.B.; Oliveira, R.G.d.; Reyes, D.R.A.; Garcia, G.A.; Floriano, J.F.; Shetty, R.H.L.; Mareco, E.A.; Dal-Pai-Silva, M.; Payão, S.L.M.; Souza, F.P.d.; et al. Transcriptomic Profiling of Rectus Abdominis Muscle in Women with Gestational Diabetes-Induced Myopathy: Characterization of Pathophysiology and Potential Muscle Biomarkers of Pregnancy-Specific Urinary Incontinence. *Int. J. Mol. Sci.* **2022**, *23*, 12864. <https://doi.org/10.3390/ijms232112864>

Academic Editor:
Maurizio Delvecchio

Received: 29 September 2022

Accepted: 19 October 2022

Published: 25 October 2022

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Copyright: © 2022 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

- ¹ Department of Gynecology and Obstetrics, Botucatu Medical School (FMB), São Paulo State University (UNESP), Botucatu 18618-687, Brazil
 - ² Postgraduate Program in Materials Science and Technology (POSMAT), School of Sciences, São Paulo State University (UNESP), Bauru 17033-360, Brazil
 - ³ Center for Biotechnology, Pravara Institute of Medical Sciences (Deemed to be University), Rahata Taluk, Ahmednagar District, Loni 413736, India
 - ⁴ Environment and Regional Development Graduate Program, University of Western São Paulo (UNOESTE), Presidente Prudente 19050-680, Brazil
 - ⁵ Department of Structural and Functional Biology, Institute of Biosciences, São Paulo State University (UNESP), Botucatu 18618-689, Brazil
 - ⁶ Department of Genetics, Faculdade de Medicina de Marília (FAMEMA), Marília 17519-030, Brazil
 - ⁷ Department of Physics, UNESP-IBILCE, São José do Rio Preto 15054-000, Brazil
 - ⁸ Department of Obstetrics and Gynecology, Weill Cornell Medicine, New York, NY 10065, USA
 - ⁹ Laboratory of Virology, Institute of Tropical Medicine, University of São Paulo Faculty of Medicine, São Paulo 05403-000, Brazil
 - ¹⁰ Cellular and Molecular Physiology Laboratory (CMPL), Department of Obstetrics, Division of Obstetrics and Gynaecology, School of Medicine, Faculty of Medicine, Pontificia Universidad Católica de Chile, Santiago 8330024, Chile
 - ¹¹ Department of Physiology, Faculty of Pharmacy, Universidad de Sevilla, E-41012 Seville, Spain
 - ¹² Faculty of Medicine and Biomedical Sciences, University of Queensland, Herston, QLD 4029, Australia
 - ¹³ Department of Pathology and Medical Biology, University of Groningen, 9713GZ Groningen, The Netherlands
 - ¹⁴ Tecnológico de Monterrey, Eutra, The Institute for Obesity Research (IOR), School of Medicine and Health Sciences, Monterrey 64710, Mexico
 - ¹⁵ Department of Physiotherapy and Occupational Therapy, School of Philosophy and Sciences, São Paulo State University (UNESP), Marília 17525-900, Brazil
- * Correspondence: marilzarudge@gmail.com
- † These authors have contributed equally to this work.
- ‡ Collaborators of the Diamater Study Group is provided in the Acknowledgments.

Abstract: Gestational diabetes mellitus (GDM) is recognized as a “window of opportunity” for the future prediction of such complications as type 2 diabetes mellitus and pelvic floor muscle disorders, including urinary incontinence and genitourinary dysfunction. Translational studies have reported that pelvic floor muscle disorders are due to a GDM-induced-myopathy (GDiM) of the pelvic floor muscle and rectus abdominis muscle (RAM). We now describe the transcriptome profiling of the RAM obtained by Cesarean section from GDM and non-GDM women with and without pregnancy-specific urinary incontinence (PSUI). We identified 650 genes in total, and the differentially expressed genes were defined by comparing three control groups to the GDM with PSUI group (GDiM). Enrichment analysis showed that GDM with PSUI was associated with decreased gene expression related to muscle structure and muscle protein synthesis, the reduced ability of muscle fibers to ameliorate muscle damage, and the altered the maintenance and generation of energy through glycogenesis. Potential genetic muscle biomarkers were validated by RT-PCR, and their relationship to the pathophysiology of the disease was verified. These findings help elucidate the

Anexo 2

Parecer consubstanciado do comitê de ética em pesquisa



UNESP - FACULDADE DE
FILOSOFIA E CIÊNCIAS -
CAMPUS DE MARÍLIA



PARECER CONSUBSTANCIADO DO CEP

DADOS DA EMENDA

Título da Pesquisa: EXERCÍCIOS DE CONTROLE MOTOR VERSUS EXERCÍCIOS GERAIS NA SÍNDROME DOLOROSA DO TROCÂTER MAIOR: ENSAIO CONTROLADO

Pesquisador: Guilherme Nava

Área Temática:

Versão: 4

CAAE: 87372318.1.0000.5406

Instituição Proponente: UNIVERSIDADE ESTADUAL PAULISTA JULIO DE MESQUITA FILHO

Patrocinador Principal: Financiamento Próprio

DADOS DO PARECER

Número do Parecer: 4.566.191

Apresentação do Projeto:

Introdução: A síndrome dolorosa do trocânter maior (SDTM) é um termo abrangente usado para definir dor e sensibilidade na região do trocânter maior do fêmur, que é mais comum em mulheres. O controle anormal dos movimentos dos membros inferiores e parâmetros neuromusculares deficientes podem levar à SDTM, entretanto, nenhum estudo utilizou o treinamento neuromuscular como estratégia de tratamento. **Objetivos:** Assim, este estudo tem como objetivo comparar o efeito de um protocolo de exercícios gerais versus um programa de treinamento de controle motor sobre a dor no início e após o tratamento em mulheres com SDTM.

Métodos: Este estudo randomizado com 2 braços foi desenhado seguindo os itens do protocolo padrão para estudos de intervenção. Os resultados serão relatados de acordo com os padrões consolidados das diretrizes de relatórios de ensaios. Sessenta participantes serão randomizados para receber exercícios de controle motor ou exercícios gerais. As medidas de desfecho primário serão a pontuação da dor no quadril coletada no início do estudo, 8 semanas e 60 semanas.

Conclusão: Estudos têm sugerido que a SDTM pode estar relacionada ao controle pobre do quadril e da pélvis, entretanto, nenhum estudo investigou um protocolo de exercícios focado no aumento da força dos músculos abdutores e extensores do quadril associado ao treinamento do controle pélvico, especialmente em posições de suporte unilateral, como ocorre na marcha. Este estudo ajudará a determinar se a SDTM está relacionado ao controle anormal dos movimentos dos membros inferiores.

Endereço: Av. Hygino Muzzi Filho, 737

Bairro: Campus Universitário

UF: SP

Município: MARILIA

Telefone: (14)3402-1346

CEP: 17.525-900

E-mail: cep.marilia@unesp.br



UNESP - FACULDADE DE
FILOSOFIA E CIÊNCIAS -
CAMPUS DE MARÍLIA



Continuação do Parecer: 4.566.191

Objetivo da Pesquisa:

O objetivo deste estudo é comparar o efeito de um protocolo de exercícios gerais versus um programa de treinamento de controle motor sobre a dor no início e após o tratamento em 8 e 60 semanas em mulheres com SDTM.

Avaliação dos Riscos e Benefícios:

Não há riscos para os participantes do estudo. Os benefícios serão os resultados do estudo divulgado para a comunidade científica.

Comentários e Considerações sobre a Pesquisa:

A pesquisa está bem descrita e fundamentada teoricamente e o desenho dos estudo, da forma como está descrito permite observar que o mesmo será exequível conforme cronograma apresentado.

Considerações sobre os Termos de apresentação obrigatória:

Adequados.

Recomendações:

Não há.

Conclusões ou Pendências e Lista de Inadequações:

Não há pendências.

Considerações Finais a critério do CEP:

O CEP da FFC da UNESP de MARÍLIA, em reunião ordinária de 17/02/2021, após acatar o parecer do membro relator previamente aprovado para o presente estudo e atendendo a todos os dispositivos das resoluções 466/2012, 510/2016 e complementares, bem como ter aprovado o Termo de Consentimento Livre e Esclarecido como também todos os anexos incluídos na pesquisa, resolve APROVAR o projeto de pesquisa EXERCÍCIOS DE CONTROLE MOTOR VERSUS EXERCÍCIOS GERAIS NA SÍNDROME DOLOROSA DO TROCÂTER MAIOR: ENSAIO CONTROLADO ALEATORIZADO

Este parecer foi elaborado baseado nos documentos abaixo relacionados:

Tipo Documento	Arquivo	Postagem	Autor	Situação
Declaração de Instituição e Infraestrutura	autorizacaocoleta.pdf	17/02/2021 12:25:55	CLAUDIO ROBERTO BROCANELLI	Aceito
Cronograma	cronogramaatualizado.docx	17/02/2021	CLAUDIO ROBERTO	Aceito

Endereço: Av. Hygino Muzzi Filho, 737

Bairro: Campus Universitário

CEP: 17.525-900

UF: SP

Município: MARILIA

Telefone: (14)3402-1346

E-mail: cep.marilia@unesp.br



**UNESP - FACULDADE DE
FILOSOFIA E CIÊNCIAS -
CAMPUS DE MARÍLIA**



Continuação do Parecer: 4.566.191

Cronograma	cronogramaatualizado.docx	12:25:38	BROCANELLI	Aceito
Informações Básicas do Projeto	PB_INFORMAÇÕES_BÁSICAS_1664577_E2.pdf	18/01/2021 16:11:49		Aceito
Projeto Detalhado / Brochura Investigador	Projeto_doutorado_CEP.docx	18/01/2021 16:02:51	Guilherme Nava	Aceito
Outros	Curriculo_Marcelo_Navega.pdf	16/11/2020 21:33:28	Guilherme Nava	Aceito
Outros	Curriculo_Guilherme_Nava.pdf	16/11/2020 21:32:53	Guilherme Nava	Aceito
Declaração de Instituição e Infraestrutura	Autorizacao_da_instituicao.pdf	16/11/2020 21:31:29	Guilherme Nava	Aceito
TCLE / Termos de Assentimento / Justificativa de Ausência	TCLE.docx	16/11/2020 21:29:35	Guilherme Nava	Aceito
Folha de Rosto	Folha_de_rosto.pdf	16/11/2020 21:28:16	Guilherme Nava	Aceito

Situação do Parecer:

Aprovado

Necessita Apreciação da CONEP:

Não

MARILIA, 01 de Março de 2021

**Assinado por:
SIMONE APARECIDA CAPELLINI
(Coordenador(a))**

Endereço: Av. Hygino Muzzi Filho, 737

Bairro: Campus Universitário

UF: SP

Município: MARILIA

Telefone: (14)3402-1346

CEP: 17.525-900

E-mail: cep.marilia@unesp.br

Anexo 3 – Questionários e escalas

1 – Questionário de sensibilização central

2 – Escala tampa para cinesiofobia

3 - Questionário de qualidade de vida para pacientes jovens e ativos com problemas no quadril

4 - Escala de Pensamento Catastrófico sobre a Dor

DOR & NEUROMODULAÇÃO - HCPA/CNPq (subárea 2.10.08.00 - 0)

Nome: _____
 Sexo: F () M () Escolaridade: _____
 Idade: _____ Data: ____/____/____ Testagem: _____
 N° banco: _____ Entrevistador: _____

Questionário de Sensibilização Central
Brazilian Portuguese Central Sensitization Inventory – BP–CSI

Os sintomas avaliados por este questionário se referem a sua presença diária ou na maioria dos dias dos últimos três meses.

Circule na coluna da direita a melhor resposta para cada questão.

PARTE A

1. Sinto-me cansado (a) ao acordar pela manhã.	0 Nunca	1 Raramente	2 Às vezes	3 Frequentemente	4 Sempre
2. Sinto que minha musculatura está enrijecida e dolorida.	0 Nunca	1 Raramente	2 Às vezes	3 Frequentemente	4 Sempre
3. Tenho crises de ansiedade.	0 Nunca	1 Raramente	2 Às vezes	3 Frequentemente	4 Sempre
4. Costumo apertar (ranger) os dentes.	0 Nunca	1 Raramente	2 Às vezes	3 Frequentemente	4 Sempre
5. Tenho diarreia e/ou prisão de ventre.	0 Nunca	1 Raramente	2 Às vezes	3 Frequentemente	4 Sempre
6. Preciso de ajuda para fazer as tarefas diárias.	0 Nunca	1 Raramente	2 Às vezes	3 Frequentemente	4 Sempre
7. Sou sensível à luminosidade excessiva.	0 Nunca	1 Raramente	2 Às vezes	3 Frequentemente	4 Sempre
8. Canso-me facilmente ao realizar atividades diárias que exigem algum esforço físico.	0 Nunca	1 Raramente	2 Às vezes	3 Frequentemente	4 Sempre
9. Sinto dor em todo o corpo.	0 Nunca	1 Raramente	2 Às vezes	3 Frequentemente	4 Sempre
10. Tenho dores de cabeça.	0 Nunca	1 Raramente	2 Às vezes	3 Frequentemente	4 Sempre
11. Sinto desconforto e/ou ardência ao urinar.	0 Nunca	1 Raramente	2 Às vezes	3 Frequentemente	4 Sempre
12. Durmo mal.	0 Nunca	1 Raramente	2 Às vezes	3 Frequentemente	4 Sempre
13. Tenho dificuldade para me concentrar.	0 Nunca	1 Raramente	2 Às vezes	3 Frequentemente	4 Sempre
14. Tenho problemas de pele como ressecamento, coceira e vermelhidão.	0 Nunca	1 Raramente	2 Às vezes	3 Frequentemente	4 Sempre
15. O estresse piora meus sintomas.	0 Nunca	1 Raramente	2 Às vezes	3 Frequentemente	4 Sempre

16. Me sinto triste ou deprimido(a).	<i>0</i> <i>Nunca</i>	<i>1</i> <i>Raramente</i>	<i>2</i> <i>Às vezes</i>	<i>3</i> <i>Frequentemente</i>	<i>4</i> <i>Sempre</i>
17. Tenho pouca energia.	<i>0</i> <i>Nunca</i>	<i>1</i> <i>Raramente</i>	<i>2</i> <i>Às vezes</i>	<i>3</i> <i>Frequentemente</i>	<i>4</i> <i>Sempre</i>
18. Tenho tensão muscular no pescoço e nos ombros.	<i>0</i> <i>Nunca</i>	<i>1</i> <i>Raramente</i>	<i>2</i> <i>Às vezes</i>	<i>3</i> <i>Frequentemente</i>	<i>4</i> <i>Sempre</i>
19. Tenho dor no queixo.	<i>0</i> <i>Nunca</i>	<i>1</i> <i>Raramente</i>	<i>2</i> <i>Às vezes</i>	<i>3</i> <i>Frequentemente</i>	<i>4</i> <i>Sempre</i>
20. Fico enjoado (a) e tonto (a) com cheiros como o de perfumes.	<i>0</i> <i>Nunca</i>	<i>1</i> <i>Raramente</i>	<i>2</i> <i>Às vezes</i>	<i>3</i> <i>Frequentemente</i>	<i>4</i> <i>Sempre</i>
21. Preciso urinar frequentemente.	<i>0</i> <i>Nunca</i>	<i>1</i> <i>Raramente</i>	<i>2</i> <i>Às vezes</i>	<i>3</i> <i>Frequentemente</i>	<i>4</i> <i>Sempre</i>
22. Quando vou dormir à noite sinto minhas pernas inquietas e desconfortáveis.	<i>0</i> <i>Nunca</i>	<i>1</i> <i>Raramente</i>	<i>2</i> <i>Às vezes</i>	<i>3</i> <i>Frequentemente</i>	<i>4</i> <i>Sempre</i>
23. Tenho dificuldade para me lembrar das coisas.	<i>0</i> <i>Nunca</i>	<i>1</i> <i>Raramente</i>	<i>2</i> <i>Às vezes</i>	<i>3</i> <i>Frequentemente</i>	<i>4</i> <i>Sempre</i>
24. Sofri trauma emocional na infância.	<i>0</i> <i>Nunca</i>	<i>1</i> <i>Raramente</i>	<i>2</i> <i>Às vezes</i>	<i>3</i> <i>Frequentemente</i>	<i>4</i> <i>Sempre</i>
25. Tenho dor na região pélvica.	<i>0</i> <i>Nunca</i>	<i>1</i> <i>Raramente</i>	<i>2</i> <i>Às vezes</i>	<i>3</i> <i>Frequentemente</i>	<i>4</i> <i>Sempre</i>
TOTAL:					

Você recebeu de algum médico algum (s) diagnóstico (s) dos citadas abaixo?

Preencha as colunas da direita para cada diagnóstico.

PARTE B	<i>Não</i>	<i>Sim</i>	<i>Ano do Diagnóstico</i>
1. Síndrome das pernas inquietas.			
2. Síndrome da fadiga crônica.			
3. Fibromialgia.			
4. Disfunção da articulação temporomandibular (ATM).			
5. Enxaqueca ou cefaleia tensional.			
6. Síndrome do intestino (cólon) irritável.			
7. Hipersensibilidade química (ex. poeira, cosméticos, poluição).			
8. Lesão cervical (incluindo lesão de chicote).			
9. Ansiedade ou ataques de pânico.			
10. Depressão.			

Escala Tampa para Cinesiofobia

Aqui estão algumas das coisas que outros pacientes nos contaram sobre sua dor. Para cada afirmativa, por favor, indique um numero de 1 a 4, caso você concorde ou discorde da afirmativa. Primeiro você vai pensar se concorda ou discorda e depois, se totalmente ou parcialmente.

	Discordo totalmente	Discordo parcialmente	Concordo parcialmente	Concordo totalmente
1. Eu tenho medo que eu possa me machucar se eu fizer exercícios.	1	2	3	4
2. Se eu tentasse superar esse medo, minha dor aumentaria.	1	2	3	4
3. Meu corpo está me dizendo que algo muito errado está acontecendo comigo.	1	2	3	4
4. Minha dor provavelmente seria aliviada se eu fizesse exercício.	1	2	3	4
5. As pessoas não estão levando minha condição médica a sério.	1	2	3	4
6. Minha lesão colocou o meu corpo em risco para o resto da minha vida.	1	2	3	4
7. A dor sempre significa que eu machuquei meu corpo.	1	2	3	4
8. Só porque alguma coisa piora minha dor, não significa que é perigoso.	1	2	3	4
9. Eu tenho medo que eu possa me machucar acidentalmente.	1	2	3	4
10. Simplesmente sendo cuidadoso para não fazer nenhum movimento desnecessário e a atitude mais segura que eu posso tomar para prevenir a piora da minha dor.	1	2	3	4
11. Eu não teria tanta dor se algo potencialmente perigoso não estivesse acontecendo no meu corpo.	1	2	3	4
12. Embora minha condição seja dolorosa, eu estaria melhor se estivesse ativo fisicamente.	1	2	3	4
13. A dor me avisa quando parar o exercício para que eu não me machuque.	1	2	3	4
14. Não é realmente seguro para uma pessoa com minha condição ser ativo fisicamente.	1	2	3	4
15. Eu não posso fazer todas as coisas que as pessoas normais fazem, porque para mim é muito fácil me machucar.	1	2	3	4
16. Embora algo esteja me causando muita dor, eu não acho que seja, de fato, perigoso.	1	2	3	4
17. Ninguém deveria fazer exercícios, quando está com dor.	1	2	3	4

Questionário de Qualidade de Vida para Pacientes Jovens e Ativos com Problemas no Quadril

Instruções

- Estas questões perguntam sobre problemas que você possa estar sentindo no seu quadril, como estes problemas afetam sua vida e quais os sentimentos que estes problemas provocam em você.

- Por favor, marque um traço no ponto que melhor representa sua situação.

» Se você marcar um traço no lado extremo da esquerda, significa que você sente que está muito prejudicado. Por exemplo:

Muito prejudicado / _____ Nenhum problema

» Se você marcar um traço no lado extremo da direita, significa que você sente que não tem nenhum problema no quadril. Por exemplo:

Muito prejudicado _____ / Nenhum problema

» Se você marcar um traço no meio da linha, significa que você sente que está moderadamente incapacitado ou, em outras palavras, que você está entre os extremos 'muito prejudicado' e 'sem nenhum problema'. É importante que você marque uma das extremidades da linha, quando as descrições extremas reflitam com exatidão a sua situação.

- Considere o último mês para responder as perguntas.

1. Em geral, você tem dor no quadril/virilha?

Muita dor _____ Nenhuma dor

2. É difícil para você abaixar e levantar-se do chão?

Muito difícil _____ Nenhuma dificuldade

3. É difícil para você caminhar longas distâncias?

Muito difícil _____ Nenhuma dificuldade

4. Qual é sua dificuldade com rangidos, travadas e estalos no seu quadril?

Muita dificuldade _____ Nenhuma dificuldade

5. Qual é sua dificuldade para empurrar, puxar, levantar ou carregar objetos pesados em seu trabalho?

Muita dificuldade _____ Nenhuma dificuldade

6. Quanto você se preocupa em mudanças rápidas de direção nos seus esportes ou atividades recreativas?

Muito _____ Não me preocupo

7. Quanta dor você sente no quadril depois de praticar alguma atividade?

Muita dor _____ Nenhuma dor

8. Quanto você se preocupa em pegar ou carregar uma criança no colo por causa de seu problema no quadril?

Muito _____ Não me preocupo

9. Quanto sua atividade sexual é prejudicada por causa do seu quadril?

☐ Isto não é importante para mim

Muito problema _____ Nenhum problema

10. Você se preocupa constantemente com seu problema de quadril?

Constantemente _____ Nunca

11. Quanto você se preocupa sobre a sua capacidade de manter o nível de preparo físico que você deseja?

Muito _____ Não me preocupo

12. A sua lesão no quadril o incomoda?

Incomoda Muito _____ Não Incomoda

FIM DO QUESTIONÁRIO! OBRIGADO!

ANEXO B

Escala de Pensamento Catastrófico sobre a Dor (B-PCS)

Nome: _____ Idade: _____ Sexo: ☐ M ☐ F Data: ____ / ____ / ____
 Escolaridade (anos completos de estudo, excluir mobral): _____

Instruções:

Listamos 13 declarações que descrevem diferentes pensamentos e sentimentos que podem lhe aparecer na cabeça quando sente dor. Indique o **GRAU** destes **pensamentos e sentimentos quando está com dor**

1	A preocupação durante todo o tempo com a duração da dor é	0 Mínima	1 leve	2 Moderada	3 Intensa	4 Muito intensa
2	O sentimento de não poder prosseguir (continuar) é	0 Mínimo	1 leve	2 Moderado	3 Intenso	4 Muito intenso
3	O sentimento que a dor é terrível e que não vai melhorar é	0 Mínimo	1 leve	2 Moderado	3 Intenso	4 Muito intenso
4	O sentimento que a dor é horrível e que você não vai resistir é	0 Mínimo	1 leve	2 Moderado	3 Intenso	4 Muito intenso
5	O pensamento de não poder mais estar com alguém é	0 Mínimo	1 leve	2 Moderado	3 Intenso	4 Muito intenso
6	O medo que a dor pode se tornar ainda pior é	0 Mínimo	1 leve	2 Moderado	3 Intenso	4 Muito intenso
7	O pensamento sobre outros episódios de dor é	0 Mínimo	1 leve	2 Moderado	3 Intenso	4 Muito intenso
8	O desejo profundo que a dor desapareça é	0 Mínimo	1 leve	2 Moderado	3 Intenso	4 Muito intenso
9	O sentimento de não conseguir tirar a dor do pensamento é	0 Mínimo	1 leve	2 Moderado	3 Intenso	4 Muito intenso
10	O pensamento que ainda poderá doer mais é	0 Mínimo	1 leve	2 Moderado	3 Intenso	4 Muito intenso
11	O pensamento que a dor é grave porque ela não quer parar é	0 Mínimo	1 leve	2 Moderado	3 Intenso	4 Muito intenso
12	O pensamento de que não há nada para fazer para diminuir a intensidade da dor é	0 Mínimo	1 leve	2 Moderado	3 Intenso	4 Muito intenso
13	A preocupação que alguma coisa ruim pode acontecer por causa da dor é	0 Mínima	1 leve	2 Moderado	3 Intenso	4 Muito intenso

APÊNDICES

Apêndice 1

Termo de Consentimento Livre e Esclarecido

TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

Você está sendo convidada a participar, como voluntária, da pesquisa clínica intitulada como “EXERCÍCIOS DE CONTROLE MOTOR VERSUS EXERCÍCIOS GERAIS NA SÍNDROME DOLOROSA DO TROCANTER MAIOR: ENSAIO CONTROLADO ALEATORIZADO”. Esta pesquisa tem por objetivo avaliar o efeito de dois protocolos de exercícios em mulheres com dor no quadril. Além disso, será feita uma análise comparativa anterior e posterior às sessões, após 8 semanas e depois de 60 semanas. Você foi selecionada por ser mulher e ter dor no quadril. Sua participação não é obrigatória. A qualquer momento você poderá desistir de participar e retirar seu consentimento. Sua recusa, desistência ou retirada de consentimento não acarretará prejuízo. Sua participação nesta pesquisa não terá custos e consistirá em fazer parte de um dos dois grupos de mulheres que serão formados, sendo que ambos os grupos realizarão exercícios físicos. Para isso, haverá um sorteio para a decisão de qual dos grupos você pertencerá. O local de realização das sessões será na Universidade Estadual Paulista, campus de Marília. O horário das sessões será definido conforme a demanda de horários das participantes, podendo sofrer ajustes. Serão no total de dezesseis sessões, com cerca de uma hora cada, e ocorrerá duas vezes por semana. Será realizada uma avaliação fisioterapêutica com testes específicos para determinar a participação na pesquisa. Serão realizados testes de força dos músculos abdutores e extensores do quadril, utilização de questionários para avaliar os aspectos psicológicos da dor, como a escala de pensamento catastrófico, questionário de sensibilização central, cinesiofobia, questionários relativos a funcionalidade do quadril, verificação do nível da dor (escala visual analógica) e percepção da melhora da dor por meio da escala de efeito global percebido, eletromiografia dos músculos da região do quadril durante a caminhada na esteira ergométrica.

Os dados obtidos por meio desta pesquisa serão confidenciais e não serão divulgados em nível individual, visando assegurar o sigilo de sua participação. O pesquisador responsável se comprometeu a tornar públicos nos meios acadêmicos e científicos os resultados obtidos de forma consolidada sem qualquer identificação de indivíduos participantes. Caso você concorde em participar desta pesquisa, assine ao final deste documento. Seguem os telefones e o endereço institucional do pesquisador responsável e do Comitê de Ética em Pesquisa – CEP, onde você poderá tirar suas dúvidas sobre o projeto e sua participação nele, agora ou a qualquer momento.

Contatos do pesquisador responsável:

Guilherme Thomaz de Aquino Nava (DOUTORANDO DO PROGRAMA DE DESENVOLVIMENTO HUMANO E TECNOLOGIAS), telefone (14) 99139-2112.

Professor Marcelo Tavella Navega (ORIENTADOR RESPONSÁVEL PELA PESQUISA - DEPARTAMENTO DE FISIOTERAPIA E TERAPIA OCUPACIONAL – DEFITO), telefone (14) 3402-1310. Endereço: Avenida Hygino Muzzi Filho, 737, Bairro Mirante, CEP 17.525-900 – Marília – SP. Declaro que entendi os objetivos, riscos e benefícios de minha participação na pesquisa, e que concordo em participar.

Marília, ____ de _____ de ____

Assinatura da participante: _____

Assinatura do pesquisador: _____

Apêndice 2
Ficha de avaliação

FICHA DE AVALIAÇÃO (DOUTORADO)

Data da avaliação: ____/____/____

Nome: _____ Idade: ____ Dominância: _____
 Grau de Instrução: _____ Profissão: _____
 Se estiver aposentada, ainda trabalha? _____ Tempo de dor _____
 Tel: () _____ - _____ Cel: () _____ - _____ Outro: () _____ - _____
 Endereço: _____ Nº _____ Bairro: _____
 Cidade: _____ Estado: _____

1- Faz uso de alguma medicação pra dor? Sim () Não ()

Qual? _____ Última vez que usou?

Apresenta melhora? Sim () Não ()

2- Dados Antropométricos

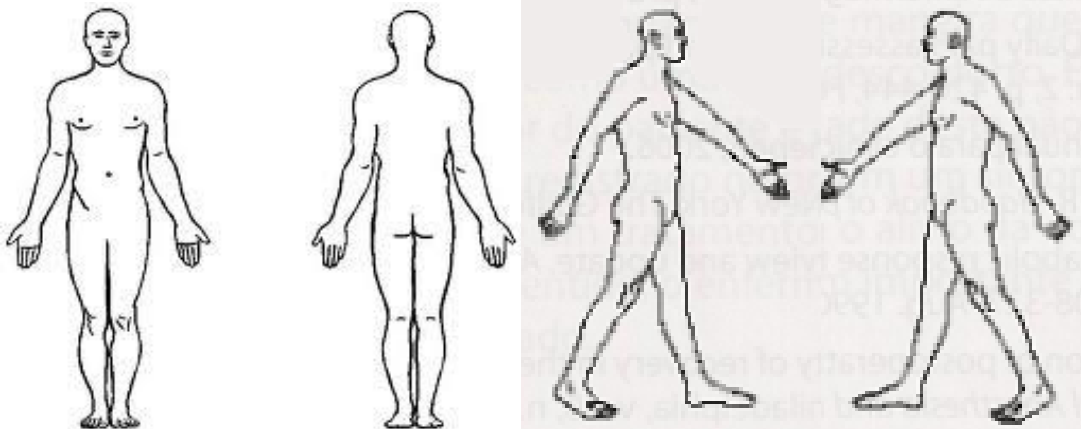
Massa Corpórea: _____ Estatura: _____ IMC: _____

3- Dor

Unilateral () ou bilateral ()

Lado avaliado: _____

Sente dor em mais algum lugar? Sim () Não () Indique com um X os locais onde sente dor.



4- Sintomas diferenciais

Sente dificuldade e/ou dor para amarrar os sapatos ou colocar as meias? Sim () Não ()

Rigidez matinal? Sim () Não ()

5- Escala Visual Analógica

Dor no quadril hoje:

Sem dor Pior dor possível

Média da dor no quadril no últimos 7 dias:

Sem dor Pior dor possível

6- Testes provocativos de dor

Dor a palpação: Positivo () Negativo ()

FADER: Sim (___) Não (___)

FADER R: Sim (___) Não (___)

FABER (patrick's): Sim (___) Não (___)

ADD: Sim (___) Não (___)

ADD R: Sim (___) Não (___)

Equilíbrio sobre uma perna 30 segundos: Sim (___) Não (___)

7- Sinal de trendelemburg

Positivo () Negativo ()

8- Teste de força muscular

Abdutores do quadril

Lado com dor:

Lado sem dor:

Teste 1:

Teste 1:

Teste 2:

Teste 2:

Teste 3:

Teste 3:

Extensores do quadril

Lado com dor:

Lado sem dor:

Teste 1:

Teste 1:

Teste 2:

Teste 2:

Teste 3:

Teste 3:

9- **Torque:** Mensurar trocânter maior do fêmur e centro do dinamômetro.

Resultado maior cm: _____

Resultado menor cm: _____

10- Eletromiografia

Familiarização por 5 minutos e avaliar 3 diferentes situações, por 1 minuto com 2 minutos de descanso: Filmagem junto com a coleta

Velocidade máxima	Velocidade mínima
Média:	
Velocidade máxima antes de correr:	
Velocidade padrão 3km/h	