Interventions for idiopathic toe walking (Protocol)

Williams CM, Pacey V, de Bakker PB, Caserta AJ, Gray K, Engelbert RHH

Interventions for idiopathic toe walking

Cyllie M Williams¹, Verity Pacey²,³, Pauline B de Bakker⁴, Antoni J Caserta⁵, Kelly Gray², Raoul HH Engelbert⁶

¹Department of Physiotherapy, Monash University, Frankston, Australia. ²Department of Endocrinology, The Children’s Hospital at Westmead, Westmead, Australia. ³Department of Health Professions, Faculty of Medicine and Health Sciences, Macquarie University, Sydney, Australia. ⁴Education for Physiotherapy, Amsterdam School of Health Professions, University of Applied Sciences Amsterdam, Amsterdam, Netherlands. ⁵Child and Family Team, Monash Health, Cranbourne, Australia. ⁶Academic Medical Center Amsterdam, Department of Rehabilitation Medicine, Amsterdam, Netherlands

Contact address: Cyllie M Williams, Department of Physiotherapy, Monash University, Frankston, Victoria, Australia. cyllie.williams@monash.edu.

Editorial group: Cochrane Neuromuscular Group


Copyright © 2016 The Cochrane Collaboration. Published by John Wiley & Sons, Ltd.

ABSTRACT

This is a protocol for a Cochrane Review (Intervention). The objectives are as follows:

To assess the effects of conservative and surgical interventions on gait normalisation, ankle range of motion, and pain in children with idiopathic toe walking (ITW), identifying adverse effects of the interventions and the frequency of recurrence.
BACKGROUND

Description of the condition

Idiopathic toe walking (ITW) is a diagnosis given to healthy children who persist in walking on their tiptoes after they should typically achieve a heel-toe gait. The estimated prevalence of ITW varies from 5% to 12% of healthy children (Engström 2012b), and commonly affects boys more than girls (Bernhard 2005; Engelbert 2011).

Children progress through a number of stages when learning to walk. Toddlers initially walk with stilted leg shuffling, then cruise around furniture before starting to walk flat-footed. As children mature, they walk with a heel-toe gait (Hallemans 2003; Norlin 1981), which comprises three distinct phases: initial heel strike, midfoot contact, and toe-off. During the development of heel-toe gait, some children walk on their tiptoes. However, toe walking is not a mandatory stage that all children will progress through and heel strike is present in most children by the age of 18 months (Sutherland 1980). A toe walking gait is described by authors as a normal variant in motor development for healthy children up to the age of 18 months (Sala 1999; Sutherland 1980), two years (Fox 2006; Hemo 2006; Stricker 1998), five years (Westberry 2008), and even until seven years of age (Kalen 1986). Some children continue to walk on their toes and parents are encouraged to seek advice from health professionals when toe walking persists. However, a lack of consensus remains on when to seek advice.

ITW is an exclusionary diagnosis given to otherwise healthy children who continue to toe walk. Many conditions are associated with a toe walking gait and exclusion of these often make the diagnosis of ITW challenging for health professionals (Engelbert 2011; Williams 2010). Toe walking may result from an inability to make heel strike due to an underlying neurological or neuromuscular disease. Conditions commonly associated with a toe walking gait include cerebral palsy (Wren 2010), muscular dystrophy (Hyde 2000), and orthopaedic problems, such as congenital talipes equinovarus (Caselli 1988). Toe walking is also commonly observed in children with autistic spectrum disorders (Barrow 2011; Ming 2007), and in children with intellectual disabilities and developmental speech and language disorders (Accardo 1989; Accardo 1992).

Persistent toe walking in healthy children was first defined by Hall 1967 as "congenital short tendo calcaneus". This definition was given because the population in this study demonstrated Achilles tendon tightness. This diagnosis was later changed to 'habitual toe walking' (Griffin 1977), and subsequently the term 'idiopathic toe walking' was introduced in 1980 (Conrad 1980). Most authors agree that ITW is a diagnosis of exclusion, made when children persist in walking on their toes with no signs of a neurologic, orthopaedic, or psychological condition (Armand 2006; Brouwer 2000; Eastwood 1997; Engstrom 2010; Griffin 1977; Hall 1967; Hemo 2006; Hicks 1988; Hirsch 2004; Kalen 1986; Kogan 2001; McMulkin 2006; Papariello 1985; Pendharkar 2012; Shulman 1997; Solan 2010; Stott 2004; Williams 2010).

The aetiology of ITW continues to be investigated. Many theories exist as to why healthy children continue to toe walk, including a hereditary genetic disorder with an autosomal dominant pattern of inheritance with variable expression (Katz 1984), an increase in the proportion of type I muscle fibres (Eastwood 1997), sensory processing difficulties (Williams 2012), and the use of infant walkers (Engelbert 1999). Some authors describe children with ITW as having the ability to walk with a heel strike, but preferring to walk on their toes (Crenna 2005; Williams 2010), and children who have ITW gait often also have limited ankle dorsiflexion (Brouwer 2000; Hall 1967; Hicks 1988; Williams 2013a).

The consequences of persistent and untreated toe walking are unclear. Untreated toe walking may lead to a higher chance of tripping or falling (Caselli 1988), or have a social or cosmetic impact (Gormley 1997; Pendharkar 2008); however, these statements are not based on systematic observations. Many authors believe intervention for ITW should be undertaken to improve any restriction in ankle range of motion, and that if no treatment is undertaken, children with ITW are at a greater chance of developing more severe limitations in this range (Bernhard 2005; Brunt 2004; Gormley 1997; Hemo 2006; Sobel 1997). However, no longitudinal studies support this supposition. On the contrary, one study that followed 80 children, of whom 48 did not receive active intervention (but underwent observation, wore modified footwear, or performed gastrocnemius and soleus stretching exercises under parental or health care professional supervision) concluded that persistent toe walking did not result in significant functional disturbance, foot deformities, or pain (Stricker 1998). Similarly, Hirsch 2004 found, in a study involving a small number (N = 11) of adolescents and adults, limited long term structural impact of toe walking, with a small percentage continuing to toe walk in the long term (N = 3, 27%). Taussig 2001 also found a spontaneous correction of ITW associated with age in 32 out of 41 children aged between three and eight years. This evidence has led authors to postulate that ITW is a benign condition that resolves spontaneously in most instances and causes a child (but not necessarily their parents) little concern while it lasts.

Description of the intervention

Treatments for ITW vary; the literature advocates conservative and surgical interventions. Young children and children without a limitation in ankle dorsiflexion are commonly treated with conservative interventions. Older children who continue toe walking and present with limitations in ankle dorsiflexion are sometimes treated with surgical procedures.

Researchers have studied many types of conservative interventions, including observation (Eastwood 2000; Eiff 2006; Stricker 1998), muscle stretching exercise programmes targeting gastrocnemius, soleus, or both (Stricker 1998), motor control intervention (Clark 2010), auditory feedback (Conrad 1980), footwear (Caselli 2002), ankle-foot or foot-only orthoses (Caselli 2002; Herring 2015; Sala 1999; Stricker 1998), serial casting (Brouwer 2000; Eastwood 2000; Griffin 1977; Katz 1984; Stott 2004; Stricker 1998), different flooring surfaces (Fanchiang 2016), and botulinum toxin A (Engstrom 2010; Engstrom 2013a; Gormley 1997). Surgical interventions include percutaneous Achilles tendon lengthening (Caselli 2002; Hemo 2006; Jahn 2009; Kogan 2001; McMulkin 2006; Stott 2004), open Achilles tendon lengthening via a Z-lengthening or slide technique (Hemo 2006), Baker's gastrocnemius-soleus lengthening (Stott 2004), and the Vulpiani procedure (gastrocnemius recession surgery) (Jahn 2009; McMulkin 2006). Most surgical interventions aim to achieve at least 10° of ankle dorsiflexion (McMulkin 2006).
How the intervention might work

Apart from simple observation, most interventions aim to lengthen the Achilles tendon, increase dorsiflexion of the ankle joint, and thereby facilitate a typical heel-toe gait pattern. Other interventions have aimed to inhibit the gait pattern, facilitate heel contact, and challenge the sensory system of the child. A short description of the mechanisms behind interventions for ITW follows.

- Observation (regular review) is used to monitor any developing limitation in ankle dorsiflexion (Eiff 2006), and identify the need for intervention.
- Stretching exercises are often prescribed in the presence of reduced ankle dorsiflexion. The Cochrane Review on 'Stretch for the treatment and prevention of contractures' describes the general theory of stretching and presents detailed evidence (Katalinic 2010).
- Ankle-foot-orthoses, full-length foot orthoses, footwear, and serial casts may prolong the time of a stretching intervention (according to the theory about stretching presented by Katalinic 2010). These devices may also physically inhibit the child from getting up on their tiptoes. These interventions are commonly used in children with good ankle dorsiflexion range of motion for gait re-education, motor control, or both (Brouwer 2000).
- Motor control intervention is based on the premise that a toe-walking gait in children older than three years may be due to motor control deficiency (Clark 2010). The motor control intervention aims to facilitate an erect standing and walking posture, and to secure a ground reaction force relative to the ankle axis.
- Augmented auditory feedback is a device that produces an auditory signal when the foot-switch is closed on heel contact (Conrad 1980). The device aims to establish a normal muscle response and heel strike gait.
- Footwear therapy utilises footwear with a rigid sole and straight last (Caselli 2002). This shoe design is thought to limit dorsiflexion at the metatarsal-phalangeal joint and thereby prevent toe walking.
- Different flooring surfaces have been utilised to challenge sensory processing abilities with different plantar tactile input (Fanchiang 2016).
- Intramuscular botulinum toxin type A injection into gastrocnemius, soleus, or both, to reduce the ability to develop plantarflexion torque, especially at the end of swing phase (Brunt 2004). Botulinum toxin type A is commonly used in children with cerebral palsy who walk on their toes. The Cochrane Review 'Botulinum toxin type A in the treatment of lower limb spasticity in cerebral palsy' describes this in detail (Ade-Hall 2000).
- Percutaneous and open Achilles tendon lengthening are surgical techniques to treat a fixed contracture of the Achilles tendon. Moreau 1987 described the procedure in more detail. Percutaneous lengthening of the Achilles tendon is generally preferred over open lengthening, because less scar formation and less pain occur (Kogan 2001).
- The Vulpius procedure for lengthening of the Achilles tendon consists of an incision of the gastrocnemius and, commonly, also the soleus fascia. The Baker procedure is a variation of the Vulpius procedure with the gastrocnemius fascia cut in a tongue-and-groove fashion instead of more transversely (Yngve 1996).

Why it is important to do this review

This systematic review is required to evaluate the evidence for any intervention for the treatment of ITW. The conclusions of this review may guide clinicians in tailoring care for children with ITW. As many of the treatments employed have financial implications for parents or healthcare services, this review also aims to highlight any deficits in the current research base.

OBJECTIVES

To assess the effects of conservative and surgical interventions on gait normalisation, ankle range of motion, and pain in children with idiopathic toe walking (ITW), identifying adverse effects of the interventions and the frequency of recurrence.

METHODS

Criteria for considering studies for this review

Types of studies

This systematic review will include randomised controlled trials (RCTs) and quasi-RCTs (using methods of allocation which are not strictly random, for example, hospital numbers or date of birth).

Types of participants

Any study involving participants diagnosed with ITW gait in the absence of a medical condition known to cause toe walking, or be associated with toe walking. As there is no universally accepted age group for ITW, this review includes ITW at any age, who have been toe walking for more than six months, who can and cannot walk with a heel-toe gait, and who may or may not have limited dorsiflexion of the ankle joint (a definition based on Eastwood 1997, Hemo 2006, Hirsch 2004, Kalen 1986, Kogan 2001, McMulkin 2006, Sala 1999, Shulman 1997, Stricker 1998, Stott 2004, and Westberry 2008).

Types of interventions

We will define conservative treatment as watchful waiting, stretching exercises (guided either by a health professional within the clinical setting and implemented within the home environment), footwear, orthoses, serial casting (with or without botulinum toxin treatment), botulinum toxin treatment (with or without serial casting), external stimulation aimed at tactile input, and feedback devices in footwear. Surgical interventions are operationally defined as all percutaneous and open procedures aimed at improving dorsiflexion of the ankle joint and regaining a typical heel-toe gait pattern. We will consider comparisons of any intervention versus another, or versus no intervention (or watchful waiting).

Types of outcome measures

These are outcomes of interest in whichever studies are included but we will not use them as criteria for selecting studies for the review.

Primary outcomes

The primary outcome will be the improvement (majority or greater than 50%) of time spent toe walking, measured by either quantifiable judgement from the child, parent, or healthcare professional, or by kinetic or kinematic gait analysis. Time frame: six months.
Secondary outcomes
1. Active range of motion of the ankle joint, measured by goniometry, degree change from baseline. Time frame: six months.
2. Passive range of motion of the ankle joint, measured by goniometry, degree change from baseline. Time frame: six months.
3. Pain, measured by different scales, e.g. visual analogue scale (VAS). Time frame: six months (change).
5. Adverse events (whereby ‘any adverse events’ are those which lead to discontinuation of treatment, and ‘serious adverse events’ are those which are fatal, life-threatening, or require prolonged hospitalisation). Depending on the type of intervention, adverse events are likely to include injuries, rupture of the Achilles tendon, weakness of the lower limb muscles due to over correction or adverse effects of botulinum toxin type A, compartment syndrome, pressure wounds from serial casting, swelling, and infection.

Search methods for identification of studies
Electronic searches
We will search the Cochrane Neuromuscular Specialised Register, the Cochrane Central Register of Controlled Trials (the current issue of the Cochrane Library), MEDLINE (1966 to the present), Embase (1980 to the present), CINAHL Plus (1937 to the present), PEDro (1929 to the present). The MEDLINE strategy is given in Appendix 1.

We will search registers of clinical trials for ongoing and recently completed trials: the World Health Organization (WHO) International Clinical Trials Registry Platform (ICTRP, apps.who.int/trialsearch), the metaRegister of Controlled Trials (mRCT, controlled-trials.com/mrct), and ClinicalTrials.gov (clinicaltrials.gov).

We will search conference proceedings and other grey literature in the BIOSIS databases and System for Information on Grey Literature in Europe (OpenGrey,.opengrey.eu). We will search guidelines via the Turning Research into Practice database (TRIP, tripdatabase.com) and National Guideline Clearinghouse (guideline.gov).

We will not apply language restrictions or restriction of search strategy to specific trial designs.

Searching other resources
We will check reference lists of included studies and journals citing the article. We will contact trial authors to identify any additional published or unpublished data.

We will contact experts in the field and trial authors for ongoing trials. There will be no limitations as to publication status (i.e. published or unpublished) or language.

Data collection and analysis
Selection of studies
Two review authors (AC and PbD) will independently screen titles and abstracts of the citations from the literature search to determine if they meet inclusion criteria. We will obtain the full-text of studies that possibly or definitely fulfil our criteria according to the abstract. We will resolve disagreements through discussion and when necessary, consult a third review author (CW). We will arrange translation of trials published in languages other than English and Dutch. We will document the study selection process in sufficient detail to complete a PRISMA flow diagram (Moher 2009).

We will give details of reasons for exclusion of studies that appear eligible, but which fail to meet our criteria in a ‘Characteristics of excluded studies’ table.

Data extraction and management
Two review authors (CW and KG) will carry out the data extraction independently. They will resolve discrepancies through discussion and when necessary, consult a third review author (VP). The review authors will use a standard data extraction form. Because of the diversity of potentially eligible studies and the ways in which they are reported, we may develop the data collection form further in the course of reviewing a sample of primary studies. We will use the form to record: information on eligibility of the study in relation to the research question, information on the methods, the population, the intervention, comparison interventions, the outcomes, the results, any adverse events, and miscellaneous information (such as funding and conflicts of interest). One review author (CW) will enter data into the Cochrane authoring and statistical software Review Manager 5 (RevMan 2014). A second review author (RE) will check the accuracy of the outcome data entry and spot-check study characteristics against trial reports.

We will document the outcome of efforts to obtain missing information from trial authors.

Assessment of risk of bias in included studies
Two review authors (VP and RE) will independently assess the risk of bias in included studies using the Cochrane ‘Risk of bias’ tool for each different outcome (Higgins 2011). We will resolve disagreements through discussion and, when necessary, consult a third review author (CW). We will attempt to obtain the information necessary for ‘Risk of bias’ assessment from the trial authors if it is not available in published reports. We will report the source of any such information in the review.

We will assess the risk of bias according to the following domains:
1. random sequence generation;
2. allocation concealment;
3. blinding of participants and personnel;
4. blinding of outcome assessment;
5. incomplete outcome data;
6. selective outcome reporting; and
7. other bias.

We will grade each potential source of bias as high, low or unclear and provide a quote from the study report together with a justification for our judgment in the ‘Risk of bias’ table. We will summarise the risk of bias judgements across different studies for each of the domains listed.

Assessment of bias in the review process
We will conduct the review according to this protocol and report any deviations from it in the ‘Differences between protocol and review’ section of the published review.

Measures of treatment effect
Continuous outcomes: changes in amount of toe walking to heel-toe gait for participants will comprise the main outcomes. If the same measurement instrument or scale is used across studies, we...
will use the mean difference (MD) to pool and compare post-treatment mean scores, with the weight given to each study determined by the precision of the estimate of effect. If different instruments or scales are used across studies, we will calculate the standardised mean difference (SMD) with a 95% confidence interval (CI) to pool and compare post-treatment mean scores.

As a rule of thumb for the interpretation of Cohen’s SMD, we will use the criteria discussed in Higgins 2011 in the Cochrane Handbook for Systematic Reviews of Interventions:

- < 0.40: small effect;
- 0.40 to 0.70: moderate effect; and
- > 0.70: large effect.

For dichotomous outcomes, we will calculate a risk ratio (RR) with a 95% CI.

Unit of analysis issues
Randomisation will need to be conducted at the level of the individual, as study outcomes will be assessed per participant not per foot. Where data on individual feet are reported, we will seek appropriate statistical analysis to assess and account for any correlation between feet. We will include cluster-randomised trials only when the intervention and control groups are totally comparable except for location and recruitment. In addition, we will include cross-over trials when all participants have received the interventions in a sequence with the participant then acting as their own control.

Dealing with missing data
We will contact trial authors to gather or clarify missing data. If we are unable to obtain these data, we will describe strategies for imputing missing data and assess the effects of these in sensitivity analyses.

Assessment of heterogeneity
We will assess heterogeneity by visual inspection of the forest plots, and the I² statistic. We will define significant heterogeneity as I² > 50% because this may represent substantial or considerable heterogeneity (Higgins 2011).

Assessment of reporting biases
If there are more than 10 trials in a single analysis, we will create funnel plots to assess publication bias; we will interpret this with caution.

Data synthesis
We will use the Review Manager 5 for data analysis and follow the guidelines of the Cochrane Handbook for Systematic Reviews of Interventions (Higgins 2011; RevMan 2014). We will use a fixed-effect analysis and perform a sensitivity analysis using a random-effects model if there is evidence of significant statistical heterogeneity. When a meta-analysis cannot be performed, we will describe the effects of interventions narratively in a qualitative synthesis.

Summary of findings andGRADE
We will create a 'Summary of findings' table using the following outcomes: disturbed gait pattern, limitation in range of motion of the ankle joint, pain, percentage of time toe walking, recurrence of ITW, and adverse effects. We will use the five GRADE considerations (study limitations, consistency of effect, imprecision, indirectness, and publication bias) to assess the quality of a body of evidence (studies that contribute data for the prespecified outcomes) (Atkins 2004). We will use methods and recommendations described in Section 8.5 and Chapter 12 of the Cochrane Handbook for Systematic Reviews of Interventions (Higgins 2011), using GRADEproGDT software (GRADEpro GDT). We will justify all decisions to down- or upgrade the quality of studies using footnotes, and we will include comments to aid readers’ understanding of the evidence grading where necessary.

Subgroup analysis and investigation of heterogeneity
Where possible, we will conduct subgroup analyses for the severity of contracture (range of joint motion of dorsiflexion of the ankle joint of more than 10°, 0° to 10°, and less than 0°). We will use ITW gait pattern as the outcome measure for subgroup analyses and use the formal test for subgroup interactions in Review Manager 5 (RevMan 2014).

Sensitivity analysis
We will consider sensitivity analyses during the review process, and if required we will:

1. repeat the analysis, excluding unpublished studies (if there are any);
2. repeat the analysis, excluding studies at high risk of bias;
3. repeat the analysis if there is one or more very large study/studies, excluding them to look at how much they dominate the results;
4. repeat the analysis to assess the effects of imputing missing data.

Acknowledgements
The review authors would like to thank the editorial team of the Cochrane Neuromuscular Group, particularly Ruth Brassington for her assistance in preparing this protocol and Angela Gunn for assisting in developing the search strategy. The review team would also like to thank Jan WH Custers for input into protocol development.

This project was supported by the National Institute for Health Research (NIHR) via Cochrane Infrastructure funding to Cochrane Neuromuscular. The views and opinions expressed herein are those of the review authors and do not necessarily reflect those of the Systematic Reviews Programme, NIHR, National Health Service, or the Department of Health. Cochrane Neuromuscular is also supported by the MRC Centre for Neuromuscular Diseases.
Additional references

Accardo 1989

Accardo 1992

Ade-Hall 2000

Arman 2006

Atkins 2004

Barrow 2011

Bernhard 2005

Brouwer 2000

Brunt 2004

Caselli 1988

Caselli 2002
Caselli MA. Habitual toe walking: learn to evaluate and treat this idiopathic childhood condition. Podiatry Management 2002;21(9):163-74.

Clark 2010

Conrad 1980

Crenna 2005

Eastwood 1997

Eastwood 2000

Eiff 2006
Eiff MP, Steiner E, Judkins DZ, Winkler-Prins V. Clinical inquiries. What is the appropriate evaluation and treatment of children who are “toe walkers”? The Journal of Family Practice 2006;55(5):447-50. [PUBMED: 16670043]

Engelbert 1999

Engelbert 2011

Engström 2010

Engström 2012b
Engström 2013a

Fanchiang 2016

Fox 2006

Gormley 1997

GRADEpro GDT [Computer program]

Griffin 1977

Hall 1967

Hallemons 2003

Hemo 2006

Herrick 2015

Hicks 1988

Higgins 2011

Hirsch 2004

Hyde 2000

Jahn 2009

Kalen 1986

Katalinic 2010

Katz 1984

Kogan 2001

McMulkin 2006
Ming 2007

Moher 2009

Moreau 1987

Nolfin 1981

Papariello 1985

Pendharkar 2008

Pendharkar 2012

RevMan 2014 [Computer program]

Sala 1999

Shulman 1997

Sobel 1997

Solan 2010

Stott 2004

Stricker 1998

Sutherland 1980

Taussig 2001

Westberry 2008

Williams 2010

Williams 2012

Williams 2013a

Wren 2010

Yngve 1996
APPENDICES

Appendix 1. MEDLINE search strategy

Database: Ovid MEDLINE(R) <1946 to January Week 4 2016>

Search Strategy:

1 randomized controlled trial.pt. (407225)
2 controlled clinical trial.pt. (90103)
3 randomi?ed. (610202)
4 placebo.ab. (173759)
5 drug therapy.fs. (1893645)
6 randomly.ab. (216000)
7 trial.ab. (899359)
8 groups.ab. (1483867)
9 or/1-8 (3791407)
10 Limit 9 to humans (3127296)
11 toe$. (29340)
13 Achilles Tendon/ (7813)
14 Ankle/ (49990)
15 (toe$1 or tiptoe$1 or tip toe$1 or achilles tendon$ or ankle joint$).tw. (76547)
16 or/12-15 (84145)
17 Walk$/ (129828)
18 Gait/ (38461)
19 Gait Disorders, Neurologic/ (4552)
20 Contract$/ (309141)
21 Equinus Deformity/ (516)
22 congenital.fs. (281344)
23 (idiopathic or habitual or walk$ or gait$ or congenital or stiff$ or equinus).tw. (587427)
24 or/17-23 (881549)
25 (infan$ or newborn$1 or new born$1 or baby$ or babies or neonat$ or perinat$ or postnat$ or child$ or schoolchild$ or kid or kids or toddler$).tw.sh. (2763088)
26 (adolesc$ or teen$ or boy$ or girl$ or minors$ or underag$ or under ag$ or juvenile$ or youth$).tw.sh. (2059906)
27 (puber$ or pubescen$ or prepubescent$ or prepubert$ or pediatric$ or paediatric$ or peadiatric$).tw. (809566)
28 (((kindergarten or schools or nursery) adj1 school$) or preschool$ or pre school$ or primary school$).tw,sh. (891 055)
29 (elementary school$ or secondary school$ or highschool$ or highschool$ or schoolage$ or school age$).tw,sh. (26782)
30 or/25-29 (3989397)
31 11 and 16 and 26 and 32 (1112)
32 remove duplicates from 31 (1 104)

CONTRIBUTIONS OF AUTHORS

Cylie M Williams will assist in the selection of studies included within the review when Antoni Caserta and Pauline B de Bakker do not reach consensus. She will carry out data extraction and assist in the assessment of methodological rigor of articles when Pauline B de Bakker and Raoul HH Engelbert do not reach consensus. She will be involved in critically reviewing the manuscript and approving the final manuscript for review.

Verity Pacey will analyse and interpret data. She will be involved in critically reviewing the initial manuscript for intellectual content (with a focus on paediatric physiotherapy), and approving the final manuscript.

Pauline B de Bakker conceptualised and designed the study. She will screen titles and abstracts for eligibility, carry out data extraction, assess the methodological rigor of the articles, analyse and interpret data, draft the initial manuscript, and approve the final manuscript of the review.

Antoni Caserta will screen titles and abstracts for eligibility, carry out data extraction, assess the methodological rigor of the articles, and analyse and interpret data. He will be involved in critically reviewing the initial manuscript for intellectual content (with a focus on paediatric podiatry), draft the initial manuscript, and approve the final manuscript of the review.

Kelly Gray will carry out data extraction. She will be involved in critically reviewing the manuscript, and approving the final manuscript for review.

Raoul HH Engelbert is involved in conceptualisation. He will be involved in critically reviewing the initial manuscript for intellectual content (with a focus on paediatric physiotherapy), assessing the risk of bias, and approving the final manuscript.

DECLARATIONS OF INTEREST

Cylie M Williams: the author has received funding and wages to undertake research and provide professional education about idiopathic toe walking. She has also published research relating to idiopathic toe walking which may feature within a review.

Verity Pacey: none known

Pauline B de Bakker: none known

Antoni J Caserta: none known

Kelly Gray: the author has received funding through the University of Sydney, medical school to attend the International Clubfoot Congress in 2011 and funding provided by the Australian Podiatry Association to present at Victorian, New South Wales, and Australian Podiatry Conferences in 2015/2016.

Raoul HH Engelbert: none known