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Shoe lifts for leg length discrepancy in adults with musculoskeletal conditions. A Bruyère Rapid Review

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Contents

Key messages

Leg length discrepancy (LLD) is associated with a range of musculoskeletal conditions such as low back pain, scoliosis, osteoarthritis (OA) of the hip or knee, and hip or knee flexion contractions.

Three guidelines recommend the use of shoe lifts, shoe modifications, or surgery for the treatment of limb length discrepancy in people with low back pain, hip and groin disorders and osteoarthritis. These recommendations are consensus-based.

We found very low quality evidence that using shoe lifts for LLD reduced pain, and improved function and range of motion. The included studies were in patients with LLD associated with back pain, hip pain or knee pain. No studies evaluated patients following total knee replacement surgery.

We found no study that assessed the use of shoe lifts after knee replacement surgery in people with OA of the knee.

We therefore suggest that:

1. Studies should be done to evaluate the effect of shoe lifts in patients with LLD due to knee flexion contracture following total knee arthroplasty. Better quality studies should be done to confirm the effectiveness of shoe lifts on pain and functional outcomes in patients with hip and back pain.

2. Knee flexion contracture is a common orthopedic problem in the geriatric population and clinical practice guidelines should be developed to address it.

Executive summary

The objective of this rapid review is to evaluate the evidence of shoe lifts on pain, function, range of motion, patient satisfaction and quality of life in adults with leg length discrepancy associated with musculoskeletal conditions such as osteoarthritis, back pain and scoliosis.

Leg length discrepancy (LLD), is a condition in which paired lower limbs are noticeably unequal. It is associated with a range of musculoskeletal conditions such as low back pain, scoliosis, osteoarthritis (OA) of the hip or knee, and hip or knee flexion contractions. LLD causes pain and poor functional outcomes and it is a complication of total hip or knee replacement surgery (arthroplasty) for OA resulting in poor patient satisfaction.

The use of shoe lifts for correcting LLD in patients with low back pain, hip or knee OA reduces pain and improves functional outcomes. However, few studies have assessed the association of LLD and knee OA. The findings of this review will support the Bruyère rehabilitation team's interest to explore the feasibility of designing a randomized controlled trial to assess the effects of using a shoe lift in the functionally shorter limb in patients with OA who have undergone total knee arthroplasty.

Given the limited availability of systematic reviews, we included a broader range of primary study designs including randomized trials, before-after studies, non-comparative cohort, case series, and case reports. Nine studies met the eligibility criteria.

We found very low quality evidence that using shoe lifts for LLD reduced pain, and improved function and range of motion. The included studies were in patients with LLD associated with back pain, hip pain or knee pain. No studies evaluated patients following total knee replacement surgery.

We also found three guidelines that recommended the use of shoe lifts, shoe modifications, or surgery for the treatment of limb length discrepancy in people with low back pain, hip and groin disorders and osteoarthritis. The recommendations were consensus-based reiterating the paucity of evidence in this area.

We therefore suggest that:

1. Studies should be done to evaluate the effect of shoe lifts in patients with LLD due to knee flexion contracture following total knee arthroplasty. Better quality, controlled studies should be done to confirm the effectiveness of shoe lifts on pain and functional outcomes in patients with hip and back pain.

2. Knee flexion contracture is a common orthopedic problem in the geriatric population and clinical practice guidelines should be developed to address it.

Background

The issue

Leg length discrepancy (LLD), is a condition in which paired lower limbs are noticeably unequal [1]. It is associated with a range of musculoskeletal conditions such as low back pain, scoliosis, osteoarthritis (OA) of the hip or knee [1-4], and hip or knee flexion contractures [5]. Musculoskeletal conditions are the most common cause of pain and disability, and second most common reason for healthcare utilization [6]. The burden of these conditions, especially chronic joint pain and low back pain increases with aging [6]. LLD also causes pain and poor functional outcomes and is a complication of total hip or knee replacement surgery (arthroplasty) for OA resulting in poor patient satisfaction [5, 7, 8].

Shoe lifts are used for LLD correction in patients with low back pain, hip or knee OA to reduce pain and improve functional outcome [3, 4, 9, 10]. However, few studies have assessed the association of LLD and knee OA [4].

Context

Bruyère Continuing Care (BCC) is the sole provider of complex continuing care in the Ottawa region and also provides rehabilitation care to diverse adult patients including the elderly. Approximately 10 to 20 percent of patients evaluated for painful musculoskeletal conditions are found to have an LLD and approximately one in ten patients have a knee flexion contracture following total knee joint arthroplasty. This amounts to a large number considering that well over 500 knee replacements are performed in Ottawa annually. Restricted joint mobility and pain associated muscle tightness result in joint contracture, leading to LLD post-total knee arthroplasty [5]. Using shoe lifts in the shorter leg after knee arthroplasty would correct LLD, reduce pain and improve functional outcomes but there is little to no evidence-based guidelines describing post-arthroplasty treatment with shoe lifts.

In a 2015 study of patients with end-stage OA who had total knee arthroplasty, the BCC rehabilitation team found that knee flexion contracture in the surgical knee was associated with post-operative knee flexion contracture in the non-surgical knee [11]. Knee flexion contracture prevents the full extension of the surgical knee joint causing loss of range of motion and functional LLD. Compensating for the unequal leg length during walking resulted in knee flexion contracture in the non-surgical leg. The BCC rehabilitation team is interested to explore the feasibility of designing a randomized controlled trial to assess the effects of using a shoe lift in the shorter leg in patients with OA who have undergone total knee arthroplasty. This rapid review is undertaken to support the Bruyère feasibility study by providing a review of findings from existing studies.

Objectives

The objective of this rapid review is to evaluate the evidence of shoe lifts on pain, function, range of motion, patient satisfaction and quality of life in adults with leg length discrepancy and musculoskeletal conditions such as osteoarthritis, back pain and scoliosis.

Methods

Eligibility and selection criteria

We planned to include clinical practice guidelines and systematic reviews. Due to the paucity of evidence, we decided to include a broader range of primary study designs including randomized trials, controlled before-after studies, cohort, case series, and case reports that met the eligibility criteria described in Table 1.

Table 1: Criteria for inclusion

	Criteria for inclusion	**Description**
P	Population	Adults with hip, knee or back symptoms and LLD. People with neurologic and neuromuscular disease are excluded.
I	Intervention	Shoe lifts to raise the whole foot, using a shoe insert, shoe extension or orthopedic device. Excluded are orthoses which raise part of the foot (e.g. lateral wedge insoles, medial wedge insoles, metatarsal wedges, and variable or constant stiffness shoes, heel lifts), orthoses, and barefoot technology.
C	Comparison	No intervention or other active intervention
O	Outcome	Reported findings on at least one of the following outcomes: pain, function, range of motion, quality of life

Literature search

We searched the Cochrane Library (CENTRAL), PubMed, PEDro and Trip database using the following search terms: shoe lifts, shoe, leg length inequality, leg length discrepancy, limb length inequality and limb length discrepancy. We identified 303 articles. See Appendix 1 for the search strategies.

We screened reference lists of potential articles and did a related article search in PubMed. We also searched the National Guideline Clearinghouse database.

Relevance assessment

We screened the search results in duplicate and disagreements were resolved by consensus. We identified 9 primary studies: one randomized controlled trial (RCT); two before-and-after studies; one non-comparative cohort study; three case series and two case reports that met our eligibility criteria. See Appendix 2 for the flow diagram and Appendix 3 for the excluded studies.

We reviewed a sample of nine guidelines relevant to leg length discrepancy and musculoskeletal conditions from high-income country settings. We selected the sample based on recency and high-income country setting. We reviewed: the American College of Rheumatology (ACR) osteoarthritis guidelines [12]; Osteoarthritis Research Society International (OARSI) guidelines [13, 14]; European League Against Rheumatism (EULAR) osteoarthritis guidelines[15]; the National Institute for Health and Care Excellence (NICE) osteoarthritis guidelines [16]; the Toward Optimized Practice (TOP) Program guideline for the Evidence-Informed Primary Care Management of Low Back Pain [17]; the American Occupational Medicine Practice Guidelines for Hip and groin disorders[18]; the American Occupational Medicine Practice Guidelines for low back disorders [19] and the Prescription Custom Foot Orthoses Practice (PCFO) Guidelines of the American College of Foot and Ankle Orthopedics and Medicine [20]. We identified three guidelines from the sample that recommended the use of shoe lifts, shoe modifications or surgery for leg length discrepancy in low back disorders, hip and groin disorders and osteoarthritis.

Critical appraisal

We assessed the quality of the included primary studies using the Cochrane risk of bias tool [21] for the RCT and the NIH quality assessment tool for before and after studies, non-comparative cohort studies, case-series and case report studies [22].

We assessed the quality of the relevant guidelines with AGREE II [23]. See Appendix 4 for details.

We also assessed the quality of the evidence with GRADE [21, 24] (see Appendix 5 for details).

Evidence review

We identified 9 studies that met the inclusion criteria: one randomized controlled trial (RCT) [2], two before after studies [9, 25], one non-comparative cohort [26], three case series [27-29] and two case reports [30, 31]. Their characteristics are summarized in Table 2.

Table 2: Characteristics of included studies

Study ID (design)	Participant population	Number of participants treated with shoe lifts	LLD measurement method	LLD Range and joint(s) assessed	Amount of correction	Pain	Function/ Disability	Quality of life	Range of motion	Patient satisfaction	Other outcome
Defrin 2005 (RCT)	General population - Outpatient physio clinic	22	Anatomic (ultrasound)	LLD (10 mm or less) and low back pain	100%	✓	✓	NA	NA	NA	NA
Golightly 2007 (CBA)	Volunteers with chronic LBP	12	Anatomic (bony landmark screen then x-ray)	LLD (**6.4**-22 mm) and low back pain	33-100% (mean 61.3%)	✓±	✓±	NA	NA	NA	NA
Friberg 1983 (Cohort)	General population (pain group Finnish army conscripts (controls	290	Anatomic (x-ray)	LLD (<5 mm, >5 mm, >10 mm, >15 mm) and low back pain	A few mm's uncorrected (to avoid over-compensation)	✓	NA	NA	NA	NA	NA
Giles 1981 (Cohort)	General population (low back pain and scoliosis)	15*	Anatomic (x-ray)	LLD (≥10 mm) And low back pain	66.7 – 100% (pain) 80% (ROM)	✓	NA	NA	✓	NA	NA
Gofton 1985 (case series)	Rheumatology clinic patients	10	Clinical method and radiograph	LLD (≥10mm) and low back pain	100%	✓	NA	NA	NA	NA	NA
Helliwell 1985 (case series)	Rheumatology clinic patients (	18	Clinical orthopedic examination	LLD (≥ 20 mm) and low back pain	89%	✓	NA	NA	NA	NA	NA
Rothenberg 1988 (case series)	Rheumatology clinic patients	12	Anatomic (radiographic)	LLD (6 – 38 mm) and low back pain, hip or knee pain	Not described ("In general, one starts with a lift equal to one quarter or one half of the clinically measured inequality in leg lengths. If symptoms improve, larger lifts are gradually tried until the patient reaches maximum improvement.")	✓	NA	NA	NA	NA	NA

Study ID (design)	Participant population	Number of participants treated with shoe lifts	LLD measurement method	LLD Range and joint(s) assessed	Amount of correction	Pain	Function/ Disability	Quality of life	Range of motion	Patient satisfaction	Other outcome
Nellensteijn 2013 (case report)	Single patient with dislocated hip following THA	1	Anatomic (standing blocks)	LLD (45 mm) and hip pain	40mm	✓	NA	NA	NA	NA	NA
Delacerda 1981 and 1982** (case report)	Single patient with prior damage to distal epiphyseal plate of right tibia	1	Anatomic (standing blocks)	LLD (28.6 mm)	100%	NA	NA	NA	NA	NA	Decreased oxygen consumption and kinematic analysis

P = Assessed and had complete or partial improvement; NA = not assessed; ü± = Assessed and no improvement in some patients

*Giles 1981 – some participants received both shoe lifts and manipulation therapy.
**Delacerda 1981 and 1982 – Delacerda 1982 is a companion case report of Delacerda 1981 with different outcomes measured in each – oxygen consumption in 1981 and kinematic analysis in 1982.

We also identified three clinical practice guidelines that recommended the use of shoe lifts or shoe modification for leg length discrepancy in low back disorders [19], hip and groin disorders [18], and osteoarthritis [20]. These recommendations were based on consensus. Synthesis of findings from primary studies

LLD was associated with various musculoskeletal conditions. Some patients had low back pain with or without scoliosis; others had hip or knee pain. One study was in patients after hip arthroplasty. One study reported the case of a patient with LLD after damage to the distal epiphyseal plate of her right tibia. LLD was measured in all patients but the magnitude was not reported in one study with patients who had hip arthroplasty. The magnitude ranged from 0-45 mm in the study populations. In one of the included studies, shoe lift therapy was administered in combination with manipulation therapy.

One small RCT with high risk of bias (no description of randomization and allocation concealment as well as no blinding) and seven observational studies (including one before-after study one cohort, three case series and two case reports with no control groups) assessed outcomes of interests.

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- **Effect of shoe lifts on pain**

One RCT showed benefit in patients with LLD and low back pain (Mean difference (MD) of 3.10, 95% CI 2.62 to 3.58; P<0.001; very low uncertainty). See Table 3.

Eight observational studies with no control also showed benefit in patients with LLD and low back pain, hip pain or knee pain. The effect size ranged from 66.7% to 100% (See Table 4).

However, we are uncertain whether shoe lifts reduce pain as the quality of the evidence is very low because of very serious study limitations.

- **Effect of shoe lifts on function or disability**

One RCT showed improvement in function in people with LLD and low back pain (MD 1.4, 95% CI 0.31 to 2.49; P<0.05; very low certainty). See Table 3.

The use of shoe lifts was found to improve function in 75% of patients with LLD and back pain in one observational studies but the overall quality of the evidence was very low (see Table 4).

- **Effect of shoe lifts on range of motion**

One observational study in patients with LLD and low back pain and scoliosis showed that shoe lifts improved range of motion; very low quality of evidence (see Table 4).

- **Effect of shoe lifts on patient satisfaction**

Patient satisfaction was not assessed in any of the studies.

- **Effect of shoe lifts on quality of life**

No study measured this outcome.

Table 3: Summary of findings table from an RCT [2]

Shoe lifts for leg length discrepancy and low back pain						
Patient or population: adults with leg length discrepancy and low back pain **Setting**: outpatient physical therapy clinic **Intervention**: shoe lifts **Comparison**: control						
Outcomes	**Anticipated absolute effects*** (95% CI)		Relative effect (95% CI)	□ of participants (studies)	Quality of the evidence (GRADE)	Comment (What it means)
	Risk with control	**Risk with shoe lifts**				
Pain VAS scale from: 0 to 15 cm (lower score means better) Follow-up: 5 to 12 weeks	The mean change in pain scores in the control group was **0.4** cm	The mean change in pain scores in the intervention group was **3.10 cm lower** (3.58 to 2.62 lower)		33 (1 RCT)	□□□□ **very low** [1,2]	We are uncertain whether shoe lifts reduce pain in adults with leg length discrepancy
Disability RMDQ scale from: 0 to 24 (lower score means better) Follow-up: 5 to 12 weeks	The mean change in disability scores in the control group was **0.3**	The mean change in disability scores in the intervention group was **1.4 lower** (2.49 to 0.31 lower)		33 (1 RCT)	□□□□ **very low** [1,2]	We are uncertain whether shoe lifts may slightly improve disability in adults with leg length discrepancy
Range of motion	Not measured	Not measured	Not estimable	-	See comment	We do not know whether shoe lifts have an effect on range of motion
Patient satisfaction	Not measured	Not measured	Not estimable	-	See comment	We do not know whether shoe lifts have an effect on patient satisfaction

Shoe lifts for leg length discrepancy and low back pain

Patient or population: adults with leg length discrepancy and low back pain
Setting: outpatient physical therapy clinic
Intervention: shoe lifts
Comparison: control

Outcomes	**Anticipated absolute effects*** (95% CI)		Relative effect (95% CI)	□ of partici-pants (studies)	Quality of the evi-dence (GRADE)	Comment (What it means)
	Risk with control	**Risk with shoe lifts**				
Quality of life	Not measured	Not measured	Not esti-mable	-	See com-ment	We do not know whether shoe lifts have an effect on quality of life

*__The risk in the intervention group__ (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).
CI: Confidence interval; **MD:** Mean difference; **RR:** Risk ratio; **RMDQ**: Roland-Morris Disability Questionnaire

GRADE Working Group grades of evidence
High quality: We are very confident that the true effect lies close to that of the estimate of the effect
Moderate quality: We are moderately confident in the effect estimate: The true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different
Low quality: Our confidence in the effect estimate is limited: The true effect may be substantially different from the estimate of the effect
Very low quality: We have very little confidence in the effect estimate: The true effect is likely to be substantially different from the estimate of effect

[1] Downgraded two levels for high risk of bias: no description of sequence generation and allocation concealment; no blinding of participants, personnel and assessors

[2] Downgraded one level for imprecision: few participants

Table 4: Summary of findings table from observational studies [9, 25-31]

Shoe lifts for leg length discrepancy and low back pain				
Patient or population: adults with leg length discrepancy and low back pain **Setting**: outpatient physical therapy clinic **Intervention**: shoe lifts **Comparison**: control				
Outcomes	**Effects of shoe lifts for leg length discrepancy**	□ of participants (studies)	Quality of the evidence (GRADE)	Comment (What it means)
Pain	Eight studies showed partial or complete pain relief ranging from 66.7 to 100%	359 (8 studies)	□□□□ **very low** [1,]	We are uncertain whether shoe lifts reduce pain in adults with leg length discrepancy
Function/ Disability	One study showed 75% improvement in function/ disability	12 (1 study)	□□□□ **very low** [1,]	We are uncertain whether shoe lifts may slightly improve disability in adults with leg length discrepancy
Range of motion	One study showed improvement in range of motion2	15 (1 study)	□□□□ **very low** [1,]	We do not know whether shoe lifts have an effect on range of motion
Patient satisfaction	No study measured patient satisfaction	-	-	We do not know whether shoe lifts have an effect on patient satisfaction
Quality of life	No study measured quality of life	-	-	We do not know whether shoe lifts have an effect on quality of life
GRADE Working Group grades of evidence **High quality:** We are very confident that the true effect lies close to that of the estimate of the effect **Moderate quality:** We are moderately confident in the effect estimate: The true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different **Low quality:** Our confidence in the effect estimate is limited: The true effect may be substantially different from the estimate of the effect **Very low quality:** We have very little confidence in the effect estimate: The true effect is likely to be substantially different from the estimate of effect				

[1] Downgraded for high risk of bias and study design (observational studies with no control groups).

[2] Some participants received combined therapy with shoe lifts and manipulation therapy.

Clinical guidelines and practice recommendations

Two of the nine guidelines reviewed recommended the use of shoe lifts, or surgery for the treatment of limb length discrepancy [18, 19] and one guideline recommended the use of shoe modifications and surgery [20]. The recommendations were consensus-based confirming the paucity of evidence in this area. One guideline [19] recommended the use of shoe lifts in people with low back pain and leg length discrepancy of > 2 cm. The other two guidelines [18, 20] did not specify the magnitude of LLD in people with hip and groin disorders and osteoarthritis. One guideline commented that shoe lifts have few adverse effects, but no supporting data was cited [18]. The three guidelines were of moderate to high quality.

Discussion

Applicability of evidence/ implementation

We sought to evaluate the evidence of shoe lifts on pain, function, range of motion, patient satisfaction and quality of life in adults with leg length discrepancy and musculoskeletal conditions such as osteoarthritis, back pain and scoliosis. We found studies in patients with LLD and osteoarthritis of the hip, knee pain, back pain and damage to the distal epiphyseal plate of right tibia.

Different outcomes were assessed in different patient populations. Pain was assessed in all except the patient with damage to the distal epiphyseal plate of right tibia. Function was assessed in patients with back pain, hip pain, knee pain, and in patients after total hip arthroplasty. Range of motion was only assessed in patients with back pain and scoliosis. The case report on the patient with LLD and damage to the distal epiphyseal plate of right tibia assessed one outcome – oxygen consumption. No study assessed quality of life and patient satisfaction.

Shoe lifts were effective on pain in patients with hip pain, knee pain and back pain. There was improved function and range of motion in patients with back pain. However, the quality of evidence is very low due to major study limitations. It is unclear if the effects of the treatment could be attributed to shoe lifts alone as some patients with back pain in one of the studies [25] received combined treatment with shoe lifts and manipulation.

We found no evidence on the effectiveness of shoe lifts in patients with LLD after hip or knee arthroplasty.

Strengths and limitations

This rapid review was undertaken to support the BCC rehabilitation team to explore the feasibility of designing a randomized controlled trial to assess the effects of using a shoe lift in patients with OA who have had total knee arthroplasty. However, we found no studies in this patient population.

The shoe lift is a simple and inexpensive intervention that could be used for the correction of leg length discrepancy in patients after hip or knee arthroplasty and in patients with low back pain. We found low quality studies confirming the effectiveness of shoe lifts on pain and function outcomes in patients with hip and back pain but the study of shoe lifts in patients with knee pain only assessed pain relief. Six studies assessed shoe lifts in patients with back pain. Most (90%) of the studies were very small with less than 50 participants. It is unclear if the effects of the treatment could be attributed to shoe lifts alone as some patients in one of the studies [25] received combined treatment with shoe lifts and manipulation.

There is disagreement about shoe lifts being the correct treatment for LLD of >20 mm magnitude [1, 10]. Other suggested treatment options are surgical correction of the LLD. We found shoe lifts to be effective on pain and function in all the included studies regardless of the magnitude of LLD (range from 0-45 mm). However, one study [9] indicated no effect in one third of the included patients with low back pain but did not state if this was related to the magnitude of the LLD. One other study [27] found partial pain relief in two patients with low back pain and their magnitude of LLD was 6 and 7 mm respectively.

Shoe lift is an inexpensive intervention and the diagnosis of LLD is sometimes overlooked leading to costly investigations such as myelograms and computed tomography (CT) scans in a search for an etiology for low back pain [27].

Implications

Based on our findings we conclude that:

1. Studies should be done to evaluate the effect of shoe lifts in patients with LLD due to knee flexion contracture following total knee arthroplasty. Better quality studies should be done to confirm the effectiveness of shoe lifts on pain and functional outcomes in patients with hip and back pain.

2. Knee flexion contracture is a common orthopedic problem in the geriatric population and clinical practice guidelines should be developed to address it.

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Appendices

Appendix 1: Search methods

Date: 19/05/2016

The Cochrane Library (CENTRAL):

Search strategy		Results
#1	Shoe lifts: ti, ab, kw (word variations have been searched)	14
#2	Adult	411903
#3	#1 and #2	14

PubMed

Search strategy		Results
#1	shoes[MeSH Terms]	5366
#2	shoes	7467
#3	shoe	9433
#4	#1 or #2 or #3	9433
#5	lifting[MeSH Terms]	2209
#6	lifting	13883
#7	lift	21410
#8	#5 or #6 or #7	21410
#9	#4 AND #8	127
#10	leg length inequality[MeSH Terms]	27
#11	leg	141675
#12	length	555753
#13	inequality	405247
#14	#11 AND #12 AND #13	3011
#15	leg length inequality	2884
#16	discrepancy	35970
#17	#11 AND #12 AND #16	1460
#18	leg length discrepancy	3578
#19	leg length discrepancy[MeSH Terms]	27
#20	#10 or #14 or #15 or #17 or #18	3705
#21	#9 AND #20	27

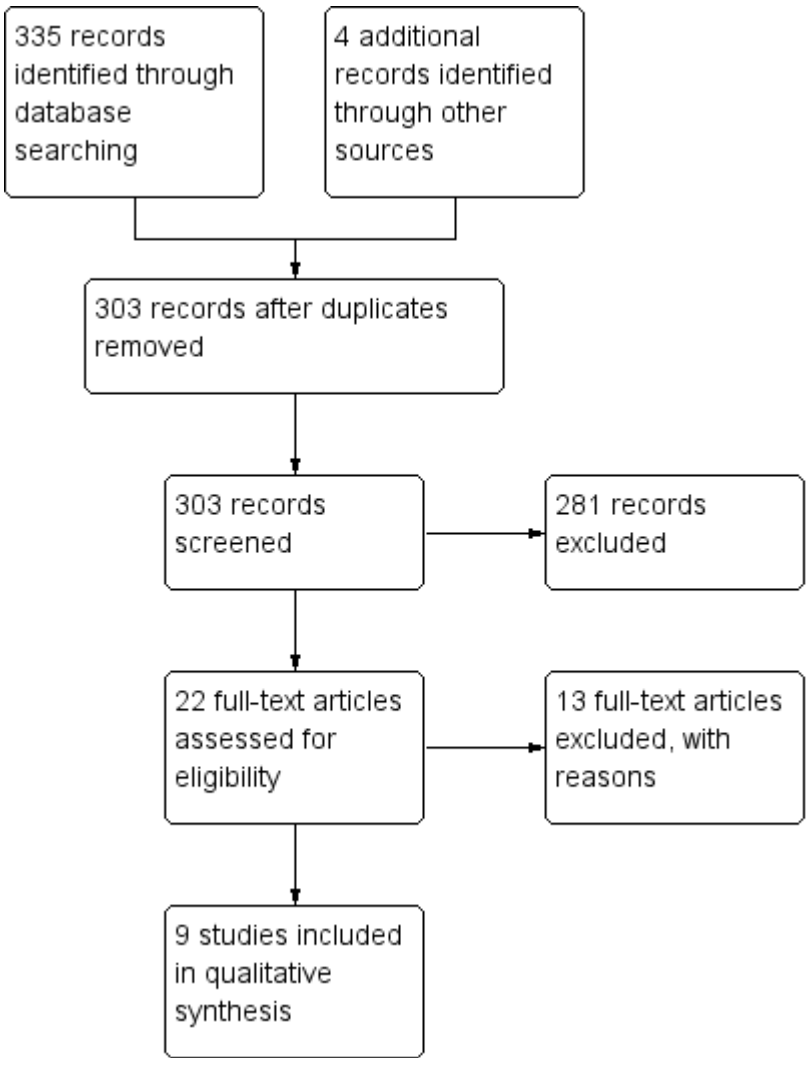
Trip Database:

Search terms	Results
Shoe lifts	187

PEDro:

Search terms	Results
Shoe lifts	0
Shoe	99
leg length discrepancy	4
leg length inequality	0
limb length discrepancy	3
limb length inequality	1
Total	107

Appendix 2: Flow diagram



Appendix 3: Excluded studies

STUDY ID	REASON FOR EXCLUSION
Abdulhadi 1996	Healthy subjects
Beaudoin 1999	Healthy subjects
Bhave 2005	Wrong intervention (customized regimen for functional problems after total hip and knee joint arthroplasty)
Bhave 2007	Wrong intervention or population (post-operative soft tissue-related functional problems in patients three months following THA). Only 5 of 78 patients were treated with shoe lifts and disaggregated results not provided.
Boone 2001	Healthy subjects
Brady 2003	Literature review
Goel 1997	Healthy subjects
Kerrigan 1997	Healthy subjects
Mahmood 2015	Wrong intervention (non-corrected LLD)
Raczkowski 2010	Wrong population (children)
Sharpe 1983	Wrong intervention (heel lift)
Vogt 2002	Healthy subjects
Zabjek 2001	Wrong population (children)

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Appendix 4: Quality assessment of included studies and guidelines

Quality assessment of included studies

Author, Year	Assessment tool Used	Source of bias	Overall Risk of Bias
Defrin 2005	Cochrane risk of bias tool	No random sequence generation (selection bias) No allocation concealment (selection bias) No blinding of participants and personnel (performance bias) No blinding of outcome assessment (detection	High
Golightly 2007	NIH quality assessment tool (Before-After)	Patient preference of treatment (Selection bias) No blinding of participants and personnel (performance bias) No blinding of outcome assessment (detection bias)	High
Friberg 1993	NIH quality assessment tool (non-comparative)	No random sequence generation (selection bias) No blinding of participants and personnel (performance bias) No blinding of outcome assessment (detection bias)	High
Giles 1981	NIH quality assessment tool (Before-After)	No random sequence generation (selection bias) No allocation concealment (selection bias) No Blinding of participants and personnel (performance bias) No blinding of outcome assessment (detection bias)	High

Author, Year	Assessment tool Used	Source of bias	Overall Risk of Bias
Gofton 1985	NIH quality assessment tool (case series)	Subject selection (selection bias) No allocation concealment (selection bias) No blinding of participants and personnel (performance bias) No blinding of outcome assessment (detection bias) No result (reporting and attrition bias) Lack of control	High
Helliwell 1985	NIH quality assessment tool (case series)	Subject selection (selection bias) No allocation concealment (selection bias) No blinding of participants and personnel (performance bias) No blinding of outcome assessment (detection bias)	High
Rothenberg 1988	NIH quality assessment tool (case series)	Subject selection (selection bias) No allocation concealment (selection bias) No blinding of participants and personnel (performance bias) No blinding of outcome assessment (detection bias) Lack of control	High
Nellensteijn 2013	NIH quality assessment tool (case report)	Subject selection (selection bias) No allocation concealment (selection bias) No blinding of participants and personnel (performance bias) No blinding of outcome assessment (detection bias)	High
Delacerda 1982	NIH quality assessment tool (case report)	Subject selection (selection bias) No allocation concealment (selection bias) No blinding of participants and personnel (performance bias) No blinding of outcome assessment (detection bias)	High

Abbreviations = NIH: National Institutes of Health

Quality assessment of included guidelines

AGREE domain	ACOEM guidelines (low back pain)	ACOEM guidelines (hip and groin)	ACFAOM guidelines
Domain 1 – scope and purpose (items 1-3)	21	21	18
Domain 2 – stakeholder involvement (items 4-6)	19	19	14
Domain 3 – Rigour of Development (items 7-14)	56	56	42
Domain 4 – Clarity of Presentation (items 15-17)	17	17	18
Domain 5 – Applicability (items 18-21)	12	12	10
Domain 6 – Editorial Independence (items 22-23)	14	14	8
Overall assessment (items 24-25)	5/yes	5/yes	4/yes
Score	**144/168**	**144/168**	**114/168**

Appendix 5: Grading of the quality of the evidence

We used the GRADE approach to assess the quality of the evidence[24]. There are four categories: high, moderate, low and very low.

Quality level	Definition
High	We are very confident that the true effect lies close to that of the estimate of the effect
Moderate	We are moderately confident in the effect estimate: The true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different
Low	Our confidence in the effect estimate is limited: The true effect may be substantially different from the estimate of the effect
Very low	We have very little confidence in the effect estimate: The true effect is likely to be substantially different from the estimate of effect

Factors that may decrease the quality level of a body of evidence

1. Limitations in the design and implementation of available studies suggesting high likelihood of bias.
2. Indirectness of evidence (indirect population, intervention, control, outcomes).
3. Unexplained heterogeneity or inconsistency of results (including problems with subgroup analyses).
4. Imprecision of results (wide confidence intervals).
5. High probability of publication bias.

Appendix 6: Glossary

Arthroplasty: is a surgical procedure in which an artificial joint replaces a damaged joint, usually a hip, knee, shoulder or ankle.

Disability: according to the World Health organization, disability covers a spectrum of various levels of functioning at the body level (impairments in body functions and structures), person level (limitations in activity) and societal level (participation restrictions). Disability therefore involves dysfunctioning at one or more of these levels: impairments, activity limitations and participation restrictions.

Joint contracture: is a deformity of the joint, the result of a stiffness or constriction in your muscles, joints, tendons, ligaments, or skin that restricts normal movement. It develops when your normally pliable connective tissues become less flexible.

Musculoskeletal conditions: are disorders that affect muscles, bones and joints and supporting structures of the upper and lower limbs, neck and back.

Orthosis: an orthopedic appliance or apparatus used to support, align, or hold parts of the body in correct position.

Osteoarthritis (OA): results from the deterioration of the cartilage in one or more joints. It leads to joint damage, pain, and stiffness. OA typically affects the hands, feet, knees, spine and hips. It is the most common type of arthritis.

Quality of life: refers to the physical, psychological, and social domains of health, seen as distinct areas that are influenced by a person's experiences, beliefs, expectations, and perceptions.

Range of motion: is the full movement potential of a joint, usually its range of flexion and extension.

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