Elastic compression stockings for prevention of deep vein thrombosis (Review)

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[Intervention Review]

Elastic compression stockings for prevention of deep vein thrombosis

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ABSTRACT

Background

One of the settings where deep vein thrombosis (DVT) in the lower limb and pelvic veins occurs is in hospital with prolonged immobilisation of patients for various surgical and medical illnesses. Using graduated compression stockings (GCS) in these patients has been proposed to decrease the risk of DVT. This is an update of a Cochrane review first published in 2000 and updated in 2003.

Objectives

To determine the magnitude of effectiveness of GCS in preventing DVT in various groups of hospitalised patients.

Search strategy

For this update the Cochrane Peripheral Vascular Diseases Group searched their Specialised Register and the Cochrane Central Register of Controlled Trials (CENTRAL) (*The Cochrane Library* 2009, Issue 4) for randomised controlled trials of elastic or graduated compression stockings for prevention of DVT.

Selection criteria

Randomised controlled trials (RCTs) involving GCS alone; or GCS used on a background of any other DVT prophylactic method.

Data collection and analysis

One author extracted the data, assessed the quality of trials and analysed the results; which were cross-checked and authenticated by a second author.

Main results

Eighteen RCTs were identified. GCS were applied on the day before surgery or on the day of surgery and were worn up until discharge or until the patients were fully mobile. In the majority of the included studies DVT was identified by the radioactive I^{125} uptake test.

For GCS alone, eight RCTs were identified involving 1279 analytic units (887 patients). In the treatment group (GCS), of 662 units, 86 developed DVT (13%) in comparison to the control group (without GCS) of 617 units where 161 (26%) developed DVT. The Peto's odds ratio (OR) was 0.35 (95% confidence interval (CI) 0.26 to 0.47) with an overall effect favouring treatment with GCS ($P < 0.00001$).

For GCS on a background of another prophylactic method, 10 RCTs were identified involving 1248 analytic units (576 patients). In the treatment group (GCS plus another method), of 621 units, 26 (4%) developed DVT, in the control group (the other method alone), of 627 units, 99 (16%) developed DVT (OR 0.25, 95% CI 0.17 to 0.36). The overall effect also favoured treatment with GCS on a background of another DVT prophylactic method (P < 0.00001).

Authors' conclusions

GCS are effective in diminishing the risk of DVT in hospitalised patients. Data examination also suggests that GCS on a background of another method of prophylaxis is more effective than GCS on its own.

PLAIN LANGUAGE SUMMARY

Elastic compression stockings for prevention of deep vein thrombosis during a hospital stay

Hospital patients can develop deep vein thrombosis (DVT) in the legs and pelvic veins immediately after surgery or if they are not mobile because of a medical illness. Symptoms vary from none to pain and swelling in the legs. A blood clot can move from the leg to the lungs with the danger of pulmonary embolism and death. Usually the DVT clears up or has long term effects such as high venous pressure in the leg, leg pain, swelling, darkening of the skin or inflammation.

DVT can be prevented using compression or drugs but drugs may cause bleeding, which is a particular concern in surgical patients. Graduated elastic compression stockings help prevent blood clots forming in the legs by applying varying amounts of pressure to different parts of the leg. Our review confirmed that graduated compression stockings reduce the risk of DVT in hospitalised patients. Our findings also suggest that wearing elastic stockings as well as receiving another method of prophylaxis has increased benefit. We identified 18 randomised controlled trials, eight comparing wearing stockings to no stockings and 10 comparing stockings plus another method with that method alone in patients undergoing surgery. The other methods used were Dextran 70, aspirin, heparin and mechanical sequential compression.

BACKGROUND

Description of the condition

The occurrence of one or more factors of Virchow's triad (stasis of blood, endothelial injury and hypercoagulability of blood) in the venous system often leads to deep vein thrombosis (DVT) (Virchow 1858). Diagnosis of DVT is difficult as patient history is not specific and symptoms vary from no symptoms to pain and swelling in the legs. The sequelae of DVT vary from complete resolution of the clot without any ill effects through to death due to pulmonary embolism. Morbidity due to DVT includes post-thrombotic syndrome which encompasses chronic venous hypertension causing limb pain, swelling, hyperpigmentation (darkening of the skin), dermatitis (inflammation of the skin), ulcers and lipodermatosclerosis (a hardening of the skin that may gain a red or brown pigmentation and is accompanied by wasting of the subcutaneous fat). Up to 30% of patients will develop features of post-thrombotic limb. The prevalence of DVT in the community is 0.2% and about 25% of hospitalised patients develop DVT (Clagett 1988). The rate of pulmonary complications is not known but in hospitalised patients up to 0.9% of deaths are due to pulmonary embolism (Lowe 1992). However, in the International Stroke Trial involving 19,435 patients with stroke the incidence of pulmonary embolism was 3.6% (IST 1997). Stroke patients were excluded from this review because they are the subject of another Cochrane review (Mazzone 2004).

Patients who are at risk of developing DVT are categorised into three groups of low, moderate and high risk according to the European Consensus Statement (ECS 1992) and Thromboembolic Risk Factor (THRIFT) consensus group guidelines (THRIFT 1992). However, the Scottish Intercollegiate Guidelines Network (SIGN) on prophylaxis of venous thromboembolism (SIGN 2002) no longer categorises patients into low, moderate and high risk groups. Instead it looks at the risk factors in hospitalised patients for developing DVT on an individual basis.

Description of the intervention

Both mechanical and pharmacological methods are used in the prevention of DVT. Pharmacological methods alter the blood coagulation profile and the major disadvantage of this is the risk of bleeding, which may be of particular concern in surgical patients. For example, the altered coagulation may lead to joint haematomas following joint replacement surgery and intracranial haemorrhage following head injury or neurosurgery. Mechanical methods include techniques such as intermittent pneumatic compression and wearing of graduated compression stockings (GCS), which have a physiological action and are used in moderate and high risk patients.

How the intervention might work

The exact mechanism by which GCS function is unknown. However, there is evidence to suggest that they exert graded circumferential pressure distally to proximally and, when combined with muscular activity in the limb, are thought to displace blood from the superficial to the deep venous system via the perforating veins. It is argued that this effectively increases the velocity and volume of flow in the deep system thereby potentially preventing thrombosis (Benko 2001).

Why it is important to do this review

Despite the theoretical effectiveness and widespread use of compression stockings their clinical effectiveness needs further appraisal. Improper application of stockings may potentially cause complications such as oedema of the legs, DVT and arterial ischaemia. Stockings may also be contraindicated for medical reasons. The extent to which the leg profile of patients may limit effectiveness has not been addressed. Recommendations regarding the ideal length of stockings (knee length versus thigh length) are not the subject of this review, however a separate Cochrane review is currently underway to assess this (Sajid 2009).

OBJECTIVES

The objective of this systematic review was to evaluate the effectiveness and safety of compression stockings as prophylaxis for DVT.

The following hypotheses were tested:

1. compression stockings are effective in preventing DVT in hospitalised patients (excluding stroke);

2. in all moderate risk patients compression stockings alone are adequate for DVT prophylaxis, except for patients where stockings are specifically contraindicated;

3. stockings are unnecessary in low risk patients;

4. complications are associated with the use of compression stockings.

METHODS

Criteria for considering studies for this review

Types of studies

Only those randomised controlled trials which involved the use of compression stockings for DVT prophylaxis were included in this systematic review. In addition, if the allocation of concealment was inadequate, or concealment not used, then these studies were excluded.

Types of participants

Patients of either sex and any age hospitalised for conditions other than stroke.

Types of interventions

Trials in which the use of GCS was compared with no prophylaxis, and those studies in which use of GCS was compared with no stockings on a background of another method of DVT prophylaxis in both the treatment and control group (for example aspirin, heparin).

Types of outcome measures

One or more of the following outcome measures were assessed.

Primary outcomes

1. Diagnosis of deep vein thrombosis (DVT) identified by ultrasound, venogram or isotope studies.
2. Effectiveness of graduated compression stockings (GCS) as a prophylactic method in preventing DVT.

Secondary outcomes

1. Diagnosis of pulmonary embolism identified by a ventilation perfusion lung scan, pulmonary angiogram, or postmortem examination.
2. Complications arising from the use of compression stockings.

Search methods for identification of studies

Electronic searches

The Cochrane Peripheral Vascular Diseases Group searched their Specialised Register (last searched January 2010) and the Cochrane Central Register of Controlled Trials (CENTRAL) in *The Cochrane Library* (last searched 2009, Issue 4) for publications describing (or which might describe) randomised controlled trials (RCTs) of elastic or graduated compression stockings for prevention of DVT. See Appendix 1 for details of the search strategy used to search CENTRAL and Appendix 2 for the terms used to search the Specialised Register .The Specialised Register is maintained by the Trials Search Co-ordinator and is constructed from weekly electronic searches of MEDLINE, EMBASE, CINAHL and AMED, and through handsearching relevant journals. The full list of the databases, journals and conference proceedings which have been searched, as well as the search strategies used, are described in the Specialised Register section of the Cochrane Peripheral Vascular Diseases Group module in *The Cochrane Library.*

Searching other resources

Reference lists of all potentially eligible studies identified from the electronic searches were scrutinised to find additional trials.

Data collection and analysis

Selection of studies

Criteria for selection of trials have been specified above. The selection of trials for inclusion in the update was carried out by two review authors (AS, MJD) and checked and approved by the two original authors of this review (SVA, TAL).
Initial screening of all retrieved studies was carried out by one author, based on titles and abstracts, to identify obvious exclusions (that is studies not relevant to the review). Where there was uncertainty regarding the relevance of a particular study a second author was consulted. The remaining records were assessed independently by two authors so as to avoid exclusion of any relevant articles at this stage. In the next stage, full papers were extracted for all remaining articles and independently assessed by two authors based on the Criteria for considering studies for this review. Where there was a disagreement between authors' judgements regarding the eligibility of relevant studies, consensus was reached by discussion with a third author. Finally, all eligible, relevant studies based on the abovementioned criteria were included in this review.

Data extraction and management

For the update, one review author (AS) performed data extraction and entered data into a data extraction form. The data were then cross-checked by another review author (MJD). Information extracted included:

- age,
- sex,
- DVT risk group to which participants belonged,
- duration of application of stockings,
- types and length of stockings,
- incidence of DVT,
- pulmonary embolism,
- adverse effects, and
- investigations used to make the diagnoses.

Assessment of risk of bias in included studies

Two review authors (AS, MJD) independently assessed the risk of bias for all the included studies using five domains: adequate sequence generation, allocation concealment, binding, incomplete outcome data and other biases. The assessment tool outlined in the Cochrane Handbook (Cochrane Handbook 2008) was used to assess whether the studies were free of potential bias and studies were marked accordingly as 'Yes' (low risk), 'No' (high risk) and 'Unclear'. If inadequate information was available, the risk of bias was reported to be 'Unclear'. Discrepancies between the review author's opinions were discussed and a consensus was reached.

Measures of treatment effect

The effectiveness of treatment (that is the use of graduated compression stockings) was assessed by recording the incidence of DVT in the treatment (stockinged) group compared to that in the control (non-stockinged) group. DVT was diagnosed using an objective method of assessment such as ultrasound, venogram or isotope studies. Individual patient data from different trials were not combined.
Analysis of the cumulative data was performed using Peto's odds ratio (with 95% confidence interval) using a fixed-effect model, which tests for heterogeneity. The statistical package provided by The Cochrane Collaboration, Review Manager 5.0.22, was used for cumulative analysis of included trials.

Unit of analysis issues

Individual patients were the analytic units, except in six trials (Bergqvist 1984; Kierkegaard 1993; Scurr 1977; Scurr 1987; Shirai 1985; Torngern 1980) where one limb was randomised to act as control and the other was treated.

Assessment of heterogeneity

The I^2 statistic is quoted to quantify heterogeneity. Heterogeneity was considered statistically significant for $P < 0.1$.

Assessment of reporting biases

Reporting bias was assessed by visual inspection of funnel plots.

Data synthesis

Data synthesis was performed under two groups, comprising:

- Group 1: GCS only in the treatment group and no propylaxis in the control group.
- Group 2: GCS in the treatment group and another method of DVT prophylaxis in both the treatment and control group.

Comparisons of results were performed, within each of these groups, using a fixed-effect model for meta-analysis.

Subgroup analysis and investigation of heterogeneity

Trials in both groups 1 and 2 were subgrouped based upon the specialty under which the patient was hospitalised. Most patients underwent either general surgical or orthopaedic surgical procedures.

Having excluded stroke patients (CLOTS 2009) only one included trial used medical patients (Kierkegaard 1993), which made it difficult to analyse results for this subgroup.

RESULTS

Description of studies

See: Characteristics of included studies; Characteristics of excluded studies; Characteristics of studies awaiting classification.

Results of the search

For this update 75 additional citations were retrieved from a search of the Specialised Register. The search of CENTRAL did not yield any additional trials for consideration.

Included studies

For this update five citations relating to two studies were added (Kalodiki 1996; Shirai 1985), which resulted in a total of 18 RCTs that met the inclusion criteria. These provided a total of 2527 analytic units (1064 legs and 1463 individual patients). See the Characteristics of included studies table.

Group 1

In Group 1, eight RCTs provided 1279 analytic units (392 legs and 887 patients). Specialties involved:

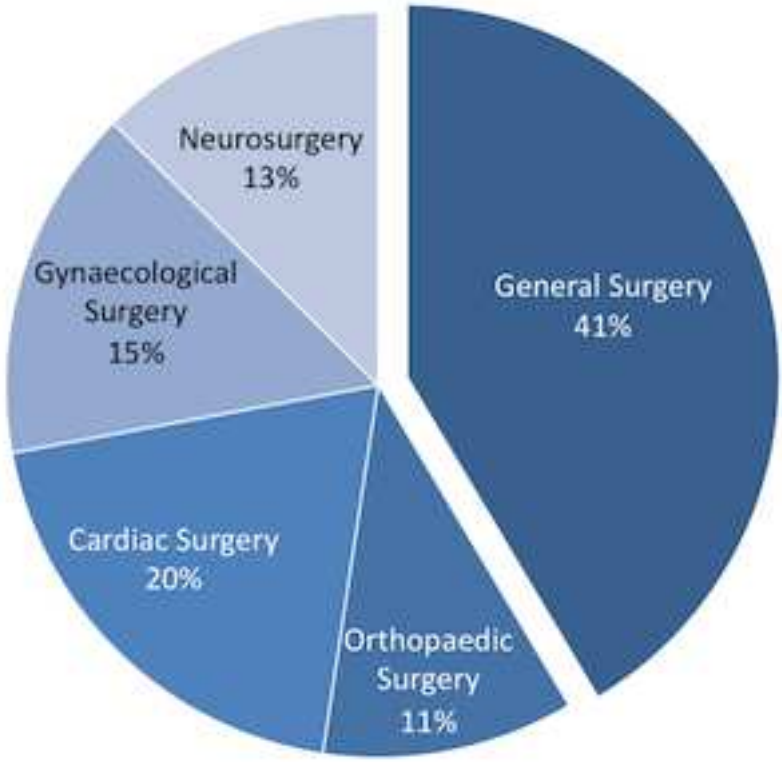
- general surgery, four trials (Allan 1983; Holford 1976; Scurr 1977; Tsapogas 1971);
- orthopaedics, one trial (Hui 1996);
- neurosurgery, one trial (Turpie 1989);
- cardiac surgery, one trial (Shirai 1985); and
- obstetrics and gynaecology, one trial (Turner 1984).

Patients in the control group received no DVT prophylaxis whereas patients in the treatment group received GCS as the method of DVT prophylaxis.

Group 1: subgroups

A total of 41% participants underwent general surgery (Figure 1) and 11% of participants underwent orthopaedic surgery (based on one trial (Hui 1996)).

Figure 1. Pie chart depicting the number of participants from each specialty in subgroup analysis for Group 1: with stockings and without stockings.



Group 2

This comprised 10 RCTs providing 1248 analytic units (672 legs and 576 patients). Specialties involved:

- general surgery, five trials (Bergqvist 1984; Scurr 1987; Torngern 1980; Wille-Jorgensen 1985; Wille-Jorgensen 1991);
- orthopaedics, four trials (Barnes 1978; Fredin 1989; Kalodiki 1996; Ohlund 1983); and
- medicine, one trial (Kierkegaard 1993).

Patients in the control group received either:

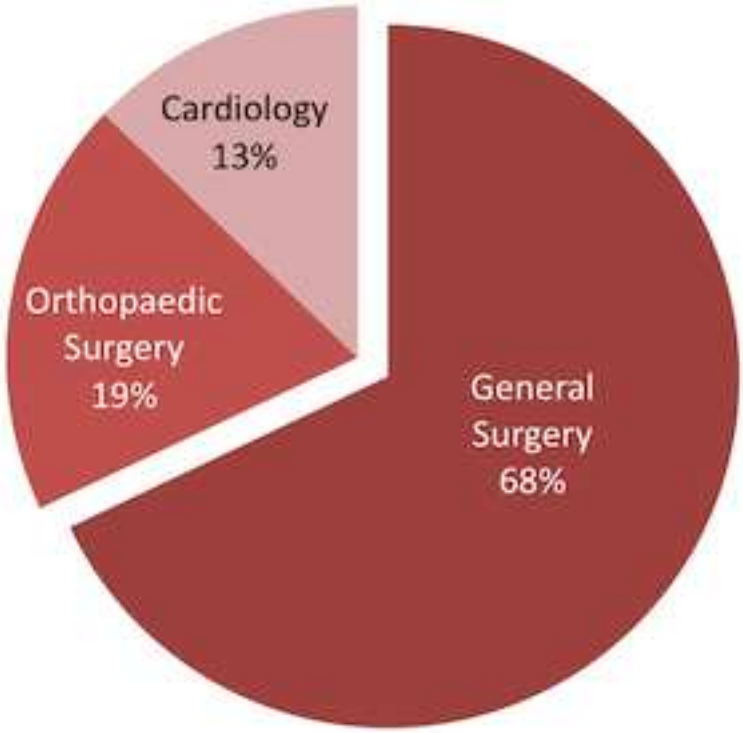
- Dextran 70 (Bergqvist 1984; Fredin 1989; Ohlund 1983),
- subcutaneous heparin (Torngern 1980; Wille-Jorgensen 1985; Wille-Jorgensen 1991),
- aspirin (Barnes 1978; Kierkegaard 1993),
- low molecular weight heparin (Kalodiki 1996), or
- sequential compression (Scurr 1987);

whereas patients in the treatment group in addition received GCS. The two trials involving aspirin (Barnes 1978; Kierkegaard 1993) were in Group 1 in the original version of this review as at that time it was thought that aspirin was effective only on the arterial side of the circulation and had little influence on the venous side. However, it has since been shown that aspirin is as effective as heparin in preventing DVT and can be used as a prophylactic method (PEP 2000; SIGN 2002). Hence, as from the previous update these studies were included under Group 2.

Group 2: subgroups

A total of 68% of participants underwent general surgery (Figure 2) and 19% of participants underwent orthopaedic surgery.

Figure 2. Pie chart depicting the number of participants from each specialty in subgroup analysis for Group 2: with stockings and without stockings on a background of additional antithrombotic measures.



In all but one of the RCTs the participants were aged 35 years and above. The exception was Turpie 1989, which involved neurosurgical patients aged 16 years and above. One trial involved patients with myocardial infarction (Kierkegaard 1993), aged 70 years and over; and one trial involved patients undergoing cardiac surgery, aged 18 to 81 years (Shirai 1985).

All trials used thigh-length GCS, except Hui 1996 which had one group of patients using thigh-length stockings and another using knee-length stockings. Both these groups were combined for the purposes of this review. One patient in the trial by Turpie 1989 wore knee-length stockings due to obesity. A Cochrane review is currently evaluating the difference in effectiveness of these two lengths of stockings (Sajid 2009). Four trials did not mention the length of the stockings used (Allan 1983; Ohlund 1983; Turner 1984; Wille-Jorgensen 1991).

In all trials GCS were applied either on the day of admission or on the day of operation. This was not critically evaluated on the assumption that all patients were fully mobile prior to surgery. In all but two of the trials the stockings were worn until the day of discharge or until the patients were fully mobile; in the remaining two studies (Fredin 1989; Turpie 1989) the patients wore GCS for 14 days or until discharge.

All RCTs used the radioactive I^{125} fibrinogen uptake (FUT) assay to screen for DVT post-operatively and phlebography to confirm the diagnosis. One trial used Doppler ultrasonography for screening and phlebography for confirmation of DVT (Barnes 1978) and two trials used only phlebography (Hui 1996; Kalodiki 1996).

Excluded studies

For this update an additional 37 citations relating to 35 studies were excluded, which resulted in a total of 47 studies being excluded from the review. See the Characteristics of excluded studies table.

The study design of 16 trials did not include the appropriate control and treatment groups for this review (Chandhoke 1991; Fasting 1985; Hansberry 1991; KANT study; Koopmann 1985; Lacut 2005; Lee 1989; Maksimovic 1996; Marston 1995; Moser 1980; Nelson 1996; Norgren 1996; Nurmohamed 1996; Porteous 1989; Ryan 2002; Silbersack 2004). One further trial was excluded as it used a retrospective control group (Caprini 1983).

Incidence of DVT was not assessed in five of the trials considered during the selection of studies for this review (Benko 2001a; Ibegbuna 1997; Lewis 1976; Manella 1981; Wilson 1994). One trial solely relied on a clinical diagnosis of DVT and did not use

an objective method for confirmation (Wilkins 1952).

One study (Rasmussen 1988) was excluded as it relied solely upon the use of Tc^{99m} plasmin test as, according to the authors, it is faster and less labour intensive compared to other tests. This test has high sensitivity (91% to 100%) but low specificity (33% to 67%) and has consequently not gained widespread use for diagnosing DVT (Bergqvist 1990). Therefore, it is likely that a number of positive results in this study may have been false positives, which may account for the high reported incidence of DVT. This necessitates the confirmation of positive results using another method, which was not done in this study. Furthermore, the method of randomisation, which was not described, did not appear to be reliable as there was a substantial difference in the number of patients allocated to the GCS group (74 patients) and GCS + heparin group (89 patients). These groups may also not be comparable due to considerable bias between the type of abdominal surgery that patients in each group underwent.

Similarly, one further trial (Cohen 2007) was excluded as it was unclear whether the protocol for diagnosis of DVT was standardised throughout the study. It was also not clear whether all patients or only selected patients were scanned routinely; how symptomatic DVTs or pulmonary embolisms (PEs) were "objectively" diagnosed, and whether this was standardised throughout the study. It seems that some patients were scanned using ultrasound and some using venography. If this was the case, the split between the two methodologies was not clear. Furthermore, patients with asymptomatic DVT only seem to have been assessed proximally; it is unclear whether they were also examined for more distal DVTs. It was also not clear which veins were examined for proximal DVTs and whether this was standardised throughout the study. The authors were contacted to seek clarification, however these queries remained unanswered at the time of publication.

Seven trials were not adequately randomised and were thus excluded from this review (Borow 1983; Ibarra-Perez 1988; Inada 1983; Ishak 1981; Liavag 1972; Moser 1976; Pitto 2008). One additional trial (Belcaro 1993) was excluded due to unclear randomisation, cause of dropouts and method of monitoring the occurrence of DVT in trial participants. The method of randomisation was not made clear in one French trial (Marescaux 1981) and this was therefore excluded from this review. One trial was not amenable to analysis, as figures were difficult to interpret (Mellbring 1986), and was therefore also excluded.

Four trials were excluded as they did not use the correct type of stockings (that is graduated compression stockings), a pre-specified criterion for inclusion. Of these, two trials used pneumatic compression (Ramos 1996; Westrich 1996), one trial used Tubigrip (Rosengarten 1970) and one trial used thick elastic compression stockings instead of thromboembolic deterrent stockings (Flanc 1969). The type of stocking used was not clear in one French trial (Patel 1988), which was thus excluded.

Two studies exclusively using stroke patients (CLOTS 2009; Muir 2000) were excluded as they are the subject of another Cochrane review (Mazzone 2004).

Three trials were only published as abstracts (Bolton 1978; Brunkwall 1991; Perkins 1999) making it difficult to accurately assess their methodology and to extract data. Two articles were excluded as they were not based on primary research, one was a review paper (Rohrer 1996) and the other a book chapter (Scholz 1979).

The study design for two studies could not be adequately assessed as the reports were not published in English (Celebi 2001; Wille-Jorgensen 1986). They therefore currently await classification. Further details can be found in the table Characteristics of studies awaiting classification.

Risk of bias in included studies

Randomisation of patients to treatment and control groups was mentioned in nine trials and was done using:

- random number tables in six trials (Allan 1983; Bergqvist 1984; Tsapogas 1971; Turner 1984; Wille-Jorgensen 1985; Wille-Jorgensen 1991);
- coin toss in one trial (Scurr 1977);
- consecutively numbered boxes in one trial (Kalodiki 1996);
- date of birth in one trial (Torngern 1980); which was deemed to be an inadequate method of randomisation.

Of these trials, the method of randomisation seemed to be unclear in two (Hui 1996; Tsapogas 1971):

- in the Tsapogas trial (Tsapogas 1971) there was a discrepancy between the numbers of patients randomised to the treatment and control groups;
- in the Hui trial (Hui 1996), which looked at the effectiveness of thigh-length versus knee-length GCS, patients were randomised in a ratio of 1:1 in the thigh-length GCS group and 1:4 in the knee-length GCS group. The control group of the thigh-length GCS group was also used as the control for the knee-length GCS group.

The method of randomisation was not mentioned in the remaining nine included trials (Barnes 1978; Fredin 1989; Holford 1976; Hui 1996; Kierkegaard 1993; Ohlund 1983; Scurr 1987; Shirai 1985; Turpie 1989).

Further details of the risks of bias are given in the Characteristics of included studies table and are represented in Figure 3 and Figure 4.

Figure 3. Methodological quality summary: review authors' judgements about each methodological quality item for each included study.

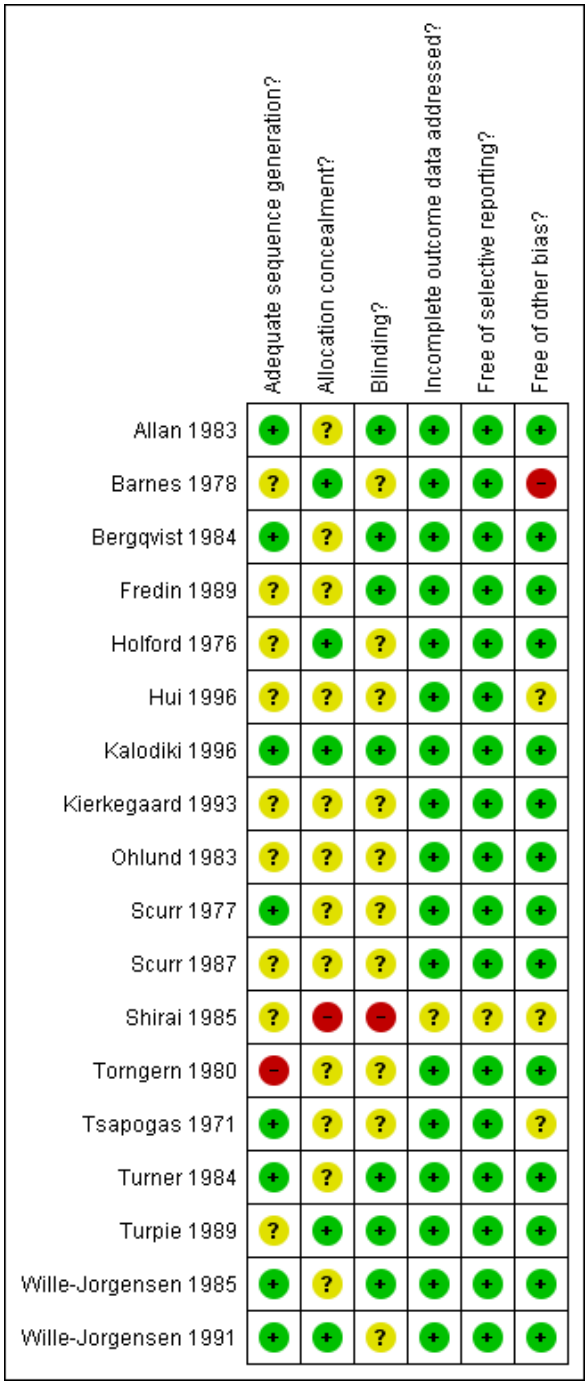
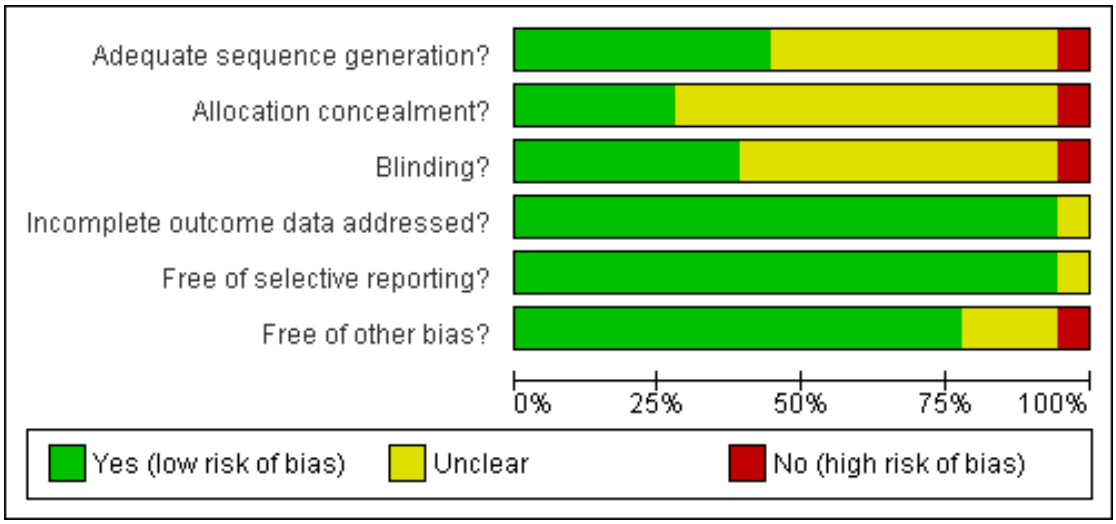


Figure 4. Methodological quality graph: review authors' judgements about each methodological quality item presented as percentages across all included studies.



Allocation

There was no mention of allocation concealment in 13 of the 18 RCTs. The remaining five studies (Barnes 1978; Holford 1976; Kalodiki 1996; Turpie 1989; Wille-Jorgensen 1991) used sealed envelopes to conceal the allocation of patients to the treatment and control groups.

Blinding

It is inherently difficult to ensure adequate blinding for patients who wear stockings and those who do not. In six trials (Allan 1983; Bergqvist 1984; Kalodiki 1996; Turner 1984; Turpie 1989; Wille-Jorgensen 1985) the radiologist reporting the scan results was unaware of whether the patient, or their leg, belonged to the treatment or control group. Also, in two trials (Fredin 1989; Kierkegaard 1993) the results of the studies were analysed without knowledge of the type of prophylaxis.

Incomplete outcome data

Results for all included patients were analysed in six trials (Barnes 1978; Kierkegaard 1993; Scurr 1987; Tsapogas 1971; Turner 1984; Turpie 1989). Patients lost to follow up were accounted for in the remaining trials, with some patients excluded post-randomisation due to failure to comply with wearing the GCS because they found them uncomfortable.

Selective reporting

Funnel plots for Group 1 (Figure 5) and Group 2 (Figure 6) showed that all included trials came within the expected confidence intervals, suggesting that the meta-analysis was free of publication bias. All included studies reported the incidence of DVTs, as stated in their aims.

Figure 5. Funnel plot of comparison for All Specialties: Group 1 - with stockings and without stockings.

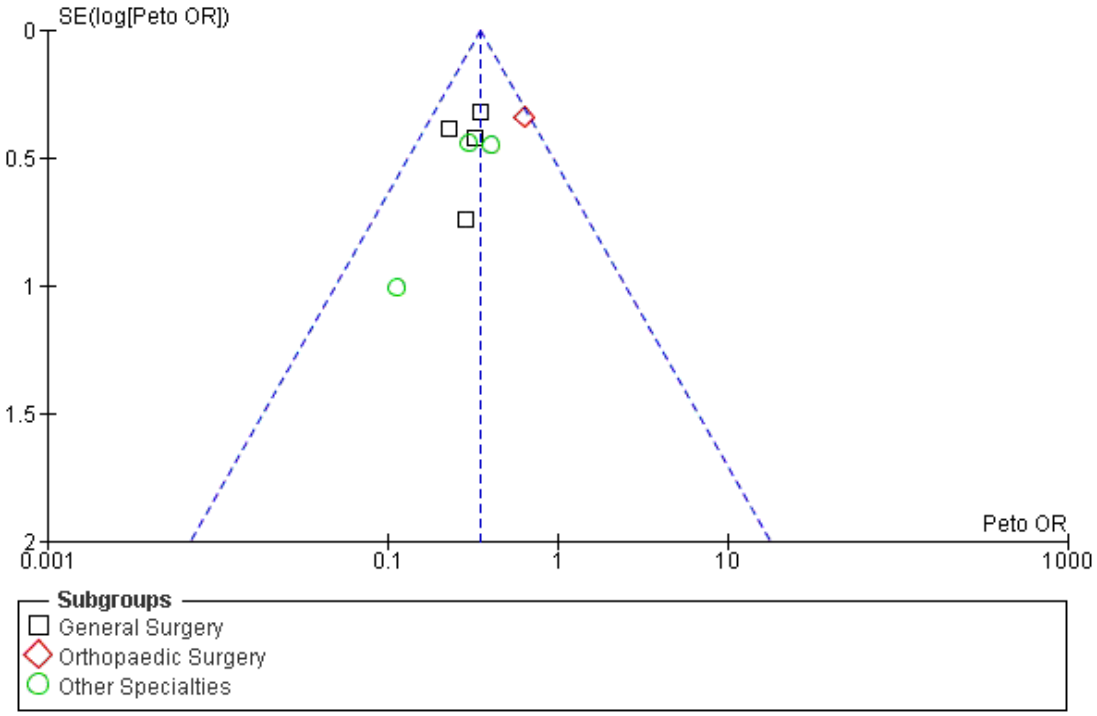
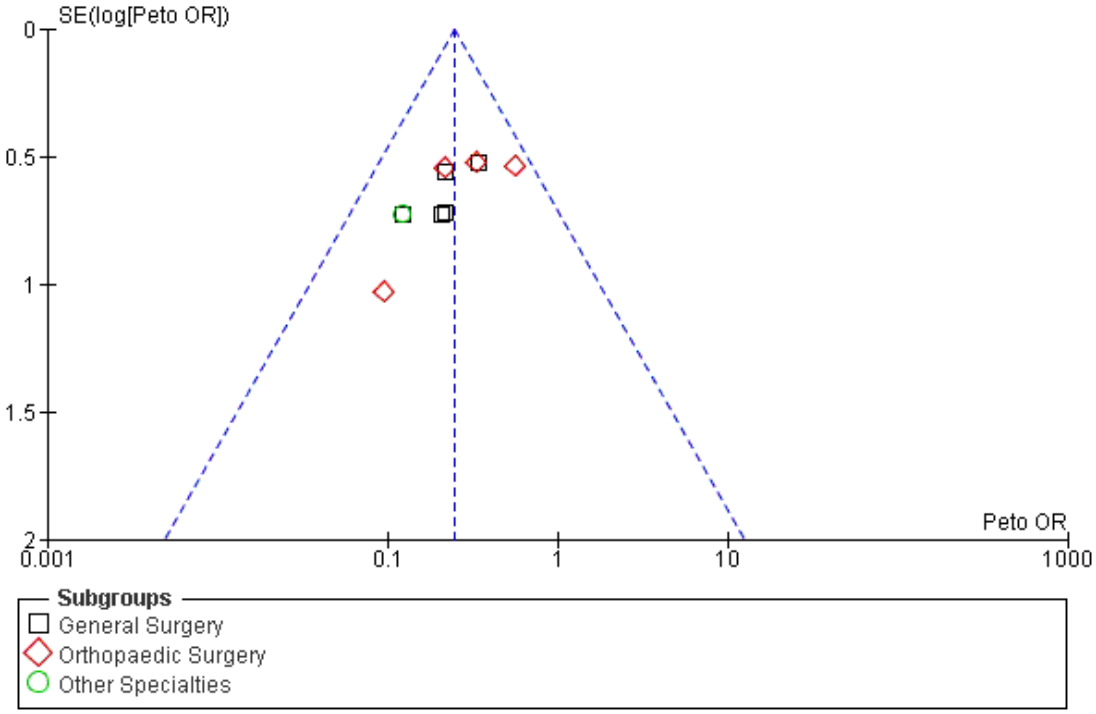


Figure 6. Funnel plot of comparison for All Specialties: Group 2 - With stockings and without stockings on a background of additional antithrombotic measures.



Other potential sources of bias

None of the trials stratified patients according to DVT risk level. However, our own analysis of the papers indicated that all patients were in either moderate or high risk groups.

Ten trials obtained stockings, funding or support from pharmaceutical companies. These companies included Kendall Co (Allan 1983; Barnes 1978; Scurr 1977; Scurr 1987; Turner 1984; Wille-Jorgensen 1985), Beiersdorf AB (Bergqvist 1984), Brevet Hospital Products (Hui 1996), Rhone-Poulenc-Rorer (Kalodiki 1996), ALKA AB (Ohlund 1983) and Novo Diagnostics (Wille-Jorgensen 1985).

One trial (Barnes 1978) was terminated early as it was deemed unjustifiable to continue after revealing a major incidence of DVT amongst patients who did not wear stockings.

In one trial (Tsapogas 1971), patients in the treatment group were given an additional recommendation regarding exercise that was not given to the control group. This may have had an influence on the risk of thrombosis.

One trial was published in Japanese (Shirai 1985), which made it difficult to accurately appraise the study design.

Effects of interventions

Results should be read with caution, paying particular attention to the notes under Description of studies as these may influence the analysis. This is because of the variations within the included trials, for example the use of the opposite limb as the control, differing background prophylactic methods used and the age difference in some of the trials. These are discussed in detail. However, in all of the included trials a statistically significant difference between the treated patients (those that used GCS) and the control group (those that did not use GCS) was demonstrated, that is the analyses did favour stockings and there was no obvious difference between subgroups.

Group 1: GCS versus no GCS

Group 1 comprised a total of 1279 participants. In the treatment group (GCS), 86 of the 662 patients developed DVT in comparison to 161 of the 617 in the control group (no GCS): Peto's odds ratio (OR) of 0.35 (95% Cl 0.26 to 0.47). This amounts to a 13% incidence of DVT in the treatment group in comparison to 26% in the control group.

Subgroup analysis

The majority of patients in this group, 530 of 1279 participants (41%) in Group 1 (Figure 1), were general surgical patients (Allan 1983; Holford 1976; Scurr 1977; Tsapogas 1971). Subgroup analysis (Analysis 1.1) revealed that the incidence of DVT in the treatment group was 36/266 (14%) and in the control group it was 94/264 (36%): Peto's OR 0.30 (95% CI 0.20 to 0.45).

Patients undergoing orthopaedic surgery accounted for 140 of 1279 participants (11%) in Group 1 (Figure 1). Subgroup analysis of patients undergoing orthopaedic surgery revealed that 38 of 86 participants (44%) from the treatment group and 30 of 54 participants (56%) from the control group developed DVT, based on one trial (Hui 1996): Peto's OR 0.64 (95% CI 0.32 to 1.25).

Similarly, other specialties did not reveal a significant difference between subgroups as they only included one trial per specialty, with small sample sizes. However, the results did favour the use of stockings: Peto's OR 0.32 (95% CI, 0.18 to 0.58).

The I^2 statistic for studies included in Group 1 suggests 0% heterogeneity, with P > 0.1 (Analysis 1.1). This is supported by the corresponding forest plot which showed that results for all studies fall within the the 95% confidence interval, using Peto's OR.

Group 2: GCS versus no GCS, with a background antithrombotic measure

Group 2 comprised a total of 1248 participants. In the treatment group (GCS plus DVT prophylaxis), 26 of the 621 patients in the treatment group developed DVT in comparison to 99 of the 627 in the control group (DVT prophylaxis alone): Peto's OR 0.25 (95% Cl 0.17 to 0.36). This amounts to a 4% incidence of DVT in the treatment group in comparison to 16% in the control group.

Subgroup analysis

Subgroup analysis (Analysis 2.1) revealed that the incidence of DVT in the treatment and control groups of patients undergoing:

- general surgery (Bergqvist 1984; Scurr 1987; Torngern 1980; Wille-Jorgensen 1985; Wille-Jorgensen 1991) was 8/421 (2%) versus 46/427 (11%), Peto's OR 0.23 (95% CI 0.13 to 0.39). General surgical patients accounted for 848 of 1248 (68%) participants in Group 2 (Figure 2);
- orthopaedic surgery (Barnes 1978; Fredin 1989; Kalodiki 1996; Ohlund 1983) was 18/120 (15%) versus 45/120 (38%), Peto's OR 0.31 (95% CI, 0.17 to 0.55). Patients undergoing orthopaedic surgery accounted for 240 of 1248 (19%) participants in Group 2 (Figure 2).

Only one trial in Group 2 considered medical patients (Kierkegaard 1993) making it difficult to comment on the effects of adjuvant therapy with stockings in these patients. However, the results did favour the use of stockings in this study: Peto's OR 0.12 (95% CI, 0.03 to 0.51).

The I^2 statistic for studies included in Group 2 suggests 0% heterogeneity, with P > 0.1 (Analysis 2.1). This is supported by the corresponding forest plot which showed that results for all studies fall within the the 95% confidence interval, using Peto's OR.

Pulmonary embolism

The incidence of pulmonary embolism was reported in eight of 18 studies (Barnes 1978; Bergqvist 1984; Fredin 1989; Holford 1976; Kalodiki 1996; Torngern 1980; Turpie 1989; Wille-Jorgensen 1985). Routine screening for PE was only conducted in two of these studies (Holford 1976; Kalodiki 1996), using perfusion-ventilation scintigraphy. This method was used to confirm clinically apparent PE in the remaining studies, except in one trial where PE (Turpie 1989) was diagnosed at autopsy.

Group 1: GCS versus no GCS

One trial (Holford 1976) reported an incidence of 0/48 (0%) in the treatment group, whereas the incidence was 1/47 (0.02%) in the control group. This difference was not statistically significant (Analysis 3.1) (Peto's OR 0.13, 95% CI 0.00 to 6.68).

One further trial (Turpie 1989) reported that one patient was diagnosed with PE at autopsy but did not state which group this patient belonged to. The cause of death of this patient was, however, found to be cerebral oedema.

Group 2: GCS versus no GCS, with a background antithrombotic measure

Three trials (Barnes 1978; Kalodiki 1996; Wille-Jorgensen 1985) reported a cumulative incidence of 13/176 (7%) in the control group and 4/173 (2%) in the treatment group. This difference was not found to be statistically significant (Analysis 3.2) but results appeared to favour the treatment group (Peto's OR 0.36, 95% CI, 0.13 to 0.99).

Two further trials (Bergqvist 1984; Fredin 1989) reported a cumulative incidence of three cases of PE, but did not specify which group these patients belonged to. One further trial (Torngern 1980) reported that none of the participants suffered fatal PE.

Adverse effects

Six of 18 trials mentioned the incidence of adverse effects but none of the trials stated which groups the patients belonged to.

In one trial (Kierkegaard 1993), some patients experienced post-phlebetic changes. Three trials (Bergqvist 1984; Fredin 1989; Wille-Jorgensen 1991) mentioned the incidence of bleeding associated with the background antithrombotic measure used. One trial (Kalodiki 1996) reported no difference in haemorrhagic complications between the treatment and control groups. One trial (Torngern 1980) reported that none of the patients showed any signs of post-operative haemorrhage or side effects.

Patients' complaints were reported in two further trials (Hui 1996; Turpie 1989). In one trial (Hui 1996) 23% of patients wearing above-knee stockings and 16% patients wearing below-knee stockings found the stockings too uncomfortable and requested their removal. Ambulant patients in another trial (Turpie 1989) reported

disturbance as the stockings fell down easily, which was likely to be due to improper fitting.

DISCUSSION

Summary of main results

The 18 RCTs analysed showed that application of GCS significantly decreased the occurrence of DVT in hospitalised post-operative patients. GCS on their own are effective in decreasing the risk of DVT, but the data obtained suggest that they are more effective on a background of another prophylactic method. However, it has to be stressed that the results from Group 2, in this respect, should be viewed with some caution as the group was heterogeneous; the background prophylactic varied between Dextran 70, heparin, aspirin and sequential compression. In addition, the patients in Group 1 and Group 2 are not necessarily a comparable population. The extent of influence of individual background prophylaxis in Group 2 could not be assessed, since further grouping would have reduced the number of patients so much that the data would not be valid.

Incidence of pulmonary embolism was reported in eight trials (Barnes 1978; Bergqvist 1984; Fredin 1989; Holford 1976; Kalodiki 1996; Turpie 1989; Torngern 1980; Wille-Jorgensen 1985) but insufficient information was available for thorough analysis. The difference in the incidence of PE in treatment and control groups was not statistically significant (Analysis 3.1, Analysis 3.2) however results generally appear to favour the use of GCS.

Few adverse events were reported. In one trial (Hui 1996) some patients removed their stockings earlier than they should have done, presumably due to discomfort. No other trials reported complications associated with wearing stockings. In one trial (Kierkegaard 1993) some patients developed post-phlebitic changes. In contrast, bleeding complications related to the associated use of heparin, Dextran or aspirin were mentioned in four studies (Bergqvist 1984; Fredin 1989; Kalodiki 1996; Wille-Jorgensen 1991) but the numbers were too small and not uniform enough to make any definitive comment.

Overall completeness and applicability of evidence

This review predominantly includes patients undergoing general surgical and orthopaedic surgical procedures (Figure 1, Figure 2) and thus provides good evidence for the use of GCS amongst these patient groups. However, only one RCT included medical patients (Kierkegaard 1993) and no trial included low risk patients. Hence we cannot comment on the benefits of using GCS in these patient groups.

The available evidence is based predominantly on the use of above knee stockings. Only one trial (Hui 1996) looked at the difference between thigh-length GCS versus no stockings and knee-length GCS versus no stockings. In five trials (Allan 1983; Kierkegaard 1993; Ohlund 1983; Turner 1984; Wille-Jorgensen 1991) the length of GCS used was not made explicit. However, the numbers were too small to draw any conclusions as to the efficacy of DVT prevention based on the length of the stockings used. This is not the remit of this review but is the subject of another Cochrane review (Sajid 2009).

None of the RCTs were uniform in detailing or recommending the duration of time that GCS should be worn post-operatively, that is up until discharge, until mobilisation or up until the next clinic visit. This aspect is important because we know from clinical experience that DVT can still occur at home after discharge and there have been a number of incidences of death after discharge that were due to DVT and pulmonary embolism. This is further supported by the recently published results from the Million Women Study (Sweetland 2009).

Quality of the evidence

Eight RCTs have been included in Group 1 (Analysis 1.1) and provide 1279 analytic units to compare the effectiveness of the use of GCS over no alternate prophylaxis. This sample size provides robust evidence to advocate the use of GCS in the clinical setting, especially amongst surgical patients since most of these patients underwent either general surgical or orthopaedic surgical procedures (Figure 1). However, subgroup analysis based on the type of procedure provides small sample sizes, making it difficult to make a judgement.

Ten RCTs have been included in Group 2 (Analysis 2.1) and provide 1248 analytic units to compare the effectiveness of GCS with a background prophylaxis. This provides robust evidence for the use of GCS on a background of additional antithrombotic measures, especially in general surgical patients who formed 68% of the sample (Figure 2). Again, the small sample size makes it difficult to judge the effectiveness of GCS with a background prophylaxis amongst the various specialties.

Potential biases in the review process

Six of the 18 included RCTs involved the use of the other leg as the control (Bergqvist 1984; Kierkegaard 1993; Scurr 1977; Scurr 1987; Shirai 1985; Torngern 1980). It is possible that GCS applied to one leg could have an effect on the other leg of the same patient (Spiro 1970), although there is no clear evidence for this. If this is true, it may bias the results of these studies. Despite such concerns,

all these trials have demonstrated that GCS significantly reduced the risk of DVT compared to when GCS were not applied.

After excluding stroke patients, only one RCT was identified that involved a medical specialty. This was in patients following a myocardial infarction (Kierkegaard 1993). Thus it is difficult to confidently comment on the effectiveness of GCS in preventing DVT in medical patients and further trials are required in this cohort of patients.

Two trials, only published as abstracts (Brunkwall 1991; Perkins 1999), were not included as they did not provide sufficient information to assess the study design. Objective diagnosis of all instances of DVT was required to ensure accuracy of results and two trials (Cohen 2007; Wilkins 1952) were, therefore, excluded from this review as they did not seem to meet this requirement.

Agreements and disagreements with other studies or reviews

NICE recently published guidance for reducing the risk of venous thromboembolism amongst hospitalised patients (NICE 2010). Their results support our finding that GCS are more effective than no prophylaxis. However, NICE recommends that GCS should not be prescribed to patients admitted for stroke. This was based primarily on the CLOTS 2009 trial in which large proportions of patients were prescribed aspirin, which may have influenced the results. It also raises the issue of lack of evidence concerning the use of mechanical prophylaxis in medical patients.

Results from this review are also comparable to those of a previous health technology assessment (Roderick 2005), which found a 66% risk reduction with the application of GCS stockings, and a 60% risk reduction when GCS stockings were used on a background of another prophylactic method. The variation in the degree of risk reduction reported by this review, as compared to our results, may be because their analyses were based upon the number of patients originally randomised in the included trials and included those patients who were later excluded. Furthermore, a number of trials included in Roderick 2005 did not meet our inclusion criteria.

AUTHORS' CONCLUSIONS

Implications for practice

There is ample evidence in this review that the use of GCS in post-surgical patients lowers the risk of DVT and, therefore, GCS should be considered in all patients at risk of development of DVT unless they have specific contraindications. There is also some observed evidence (as opposed to evidence from trials) that in these patients another method of DVT prophylaxis combined with GCS is more effective than another method alone. However, caution should be applied when combined methods of prophylaxis are used in clinical situations such as neurosurgical, orthopaedic and vascular post-operative patients.

Implications for research

There is scope for more research in this field.

1. Studies are needed to evaluate whether specific target groups such as patients in orthopaedics, those with malignancy, a past history of DVT or hypercoagulable states would benefit from the use of GCS.

2. Studies are needed to investigate the duration of DVT prophylaxis after discharge from hospital that is required to prevent DVT episodes at home.

3. The complications associated with use of GCS have not been specifically addressed in any of these RCTs. This needs to be examined further, particularly in specific groups such as orthopaedic patients, because concerns have been raised that consequent complications may outweigh their benefits if GCS are worn improperly.

4. Randomised controlled trials are needed:

i) in patients with medical illness as opposed to surgical illness,

ii) to compare above knee with below knee GCS,

iii) to compare GCS against other methods of prophylaxis.

5. Finally, the cost implications for any health service providers, and comparison with other methods, need to be assessed.

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* *Indicates the major publication for the study*

CHARACTERISTICS OF STUDIES

Characteristics of included studies *[ordered by study ID]*

Allan 1983

Methods	Study: RCT Exclusions post-randomisation: 11 Losses to follow up: 0 DVT diagnosis: Fibrinogen Uptake Test*. Scanned on 1st, 2nd, 3rd, 5th and 7th day after operation. In patients with evidence of DVT, scanning was continued until the patient left the hospital. Phlebogram performed if evidence of DVT to assess proximal involvement. Statistical analysis: Chi^2 test.
Participants	Country: UK Total number of participants: 211 Total available for analysis: 200 Age: > 40 years Sex: Male and female Inclusion criteria: Abdominal surgery greater than 30 minutes duration. Exclusion criteria: past DVT, PE, varicose veins, steroid or anticoagulant therapy.
Interventions	Type of treatment: GCS length not stated Control: 103 Treatment: 97 Duration: GCS fitted on the evening before the operation and continued until 7 days thereafter.
Outcomes	DVT Control: 37 Treatment: 15 P<0.025 PE Not mentioned.
Notes	Benign and malignant patients were differentiated: BENIGN Control: 51 DVT: 16 Treatment: 49 DVT: 5 P<0.058 MALIGNANT Control: 52 DVT: 21 Treatment: 48 DVT: 10 P<0.05 No adverse events were reported.

Risk of bias		
Item	**Authors' judgement**	**Description**

Allan 1983 (*Continued*)

Adequate sequence generation?	Yes	Patients allocated using random number series.
Allocation concealment?	Unclear	Method of concealment not described.
Blinding? All outcomes	Yes	"The scans were assessed without reference to patient or group." Comment: probably done.
Incomplete outcome data addressed? All outcomes	Yes	11/211 patients not analysed, but were accounted for.
Free of selective reporting?	Yes	Results of all outcomes were reported.
Free of other bias?	Yes	However, Kendall Co supplied the stockings and fibrinogen in the study.

Barnes 1978

Methods	Study: RCT Exclusions post randomisation: 0 Losses to follow up: 0 DVT diagnosis: Doppler ultrasound on alternate days until discharge. Venography if positive and lung perfusion scan if venography substantiates or on clinical manifestation of chest pain. Statistical analysis: Fisher exact probability.
Participants	Country: USA Total number of participants: 18 Total available for analysis: 18 Age: > 50 years Sex: Male and female Inclusion criteria: All patients admitted for hip operation Exclusion criteria: none.
Interventions	Type of treatment: GCS thigh length Control: 10 Treatment: 8 Duration: GCS fitted on the day of surgery until discharge.
Outcomes	DVT Control: 5 Treatment: 0 P< 0.029
Notes	Some had aspirin during the study, some had previous DVT, some had previous leg injuries, some had varicose veins, some with venous skin changes. Further study was stopped because of the increased incidence of DVT in the control group.

Barnes 1978 (*Continued*)

	3 patients with DVT also developed PE. Incidence of adverse events not mentioned.

Risk of bias

Item	Authors' judgement	Description
Adequate sequence generation?	Unclear	Method of randomisation not mentioned.
Allocation concealment?	Yes	Sealed envelopes were used.
Blinding? All outcomes	Unclear	Not mentioned.
Incomplete outcome data addressed? All outcomes	Yes	All 18 patients were accounted for and included in analysis.
Free of selective reporting?	Yes	Results of all outcome measures were reported.
Free of other bias?	No	This study was terminated early. "It was considered medically unjustifiable to continue this study when a significantly greater incidence of major deep vein thrombosis developed in the patients not wearing stockings." Also, authors of this study were awarded a grant from the Kendall Research Centre who manufacture stockings.

Bergqvist 1984

Methods	Study: RCT Exclusions post randomisation: 8 Losses to follow up: 0 DVT diagnosis: FUT *. Scanned 1st and subsequently every 2nd day Statistical analysis: Exact binomial test.
Participants	Country: Sweden Total number of participants: 88 Total available for analysis: 80 Age: 50 years Sex: male and female Inclusion criteria: All abdominal operations Exclusion criteria: < 50 years of age.

Bergqvist 1984 (*Continued*)

Interventions	Type of treatment: GCS thigh length Control: 80 (39 right leg and 41 left leg) Treatment: 80 (41 right leg and 39 right leg) Duration: evening before the operation till the 7th post-operative day.
Outcomes	DVT Control: 8 Treatment: 0 P<0.01
Notes	This study included the infusion of Dextran 70 as prophylactic measure in addition to stockings in both groups. Non-stockinged legs acted as control. 1 patient had symptoms of PE. Adverse events: mentions bleeding but not in a particular group.

Risk of bias

Item	**Authors' judgement**	**Description**
Adequate sequence generation?	Yes	"using a random number table."
Allocation concealment?	Unclear	Not mentioned.
Blinding? All outcomes	Yes	"When analysing the data from the fibrinogen test, it was not clear which leg was stockinged."
Incomplete outcome data addressed? All outcomes	Yes	8/80 patients were not analysed, but were accounted for.
Free of selective reporting?	Yes	Results of all outcome measures were reported.
Free of other bias?	Yes	However, stockings were supplied by Beiersdorf AB.

Fredin 1989

Methods	Study: RCT Exclusions post randomisation: 6 Losses to follow up: 0 DVT diagnosis: FUT * 1st and every alternate day for 10 days. Statistical analysis: Student's t test.
Participants	Country: Sweden Total number of patients: 150 Total available for analysis: 144

Fredin 1989 (*Continued*)

	Age: >40 years Sex: male and female Inclusion criteria: All patients for total hip arthroplasty. Exclusion criteria: Swelling of legs, leg ulcers, eczema, malignancy, varicose veins, previous DVT, previous PE and cardiovascular diseases.
Interventions	Type of treatment: GCS thigh length Control: 48 Treatment: 49 Duration: Applied on the evening before the operation for 14 days.
Outcomes	DVT Control: 13 Treatment: 3 P<0.01
Notes	All patients had regular dextran 70 prophylaxis. Only the non-operated leg's values were included for our analysis because in these orthopaedic patients thrombotic process may have already been initiated during surgery. 2 patients developed PE in the Dextran-only group. Adverse events: mentions incidence of bleeding, which might be associated with low dose heparin - 3 wound haematomas, minor bleeding from gastric drainage in 1 patient. Further 7 patients withdrawn from the trial due to bleeding, which might have also been due to heparin.

Risk of bias

Item	Authors' judgement	Description
Adequate sequence generation?	Unclear	Not mentioned.
Allocation concealment?	Unclear	Not mentioned.
Blinding? All outcomes	Yes	"The data was analysed blindly concerning the type of prophylaxis."
Incomplete outcome data addressed? All outcomes	Yes	6/150 patients were not included in analysis, but were accounted for.
Free of selective reporting?	Yes	Results of all outcome measures were reported.
Free of other bias?	Yes	

Holford 1976

Methods	Study: RCT Exclusions post-randomisation: 3 Losses to follow up: 0 DVT diagnosis: FUT * day prior to surgery and every day post operatively for 6 to 7 days. Statistical analysis: Chi^2 test with Yate's correction.
Participants	Country: UK Total number of participants: 98 Total available for analysis: 95 Age: > 40 years Sex: male and female Inclusion criteria: > 40 years of age. Major abdominal, pelvic or thoracic surgery. Exclusion criteria: None mentioned.
Interventions	Type of treatment: GCS thigh length Control: 47 Treatments: 48 Duration: applied 12 hours before surgery, and removed after patient was fully mobile (4 to 5 days later). Patients encouraged to mobilise early.
Outcomes	DVT Control: 23 Treatment: 11 P<0.01 PE Control: 1 Treatment: 0
Notes	Adverse events: not mentioned.

Risk of bias

Item	Authors' judgement	Description
Adequate sequence generation?	Unclear	"Patients were allocated randomly" Comment: No mention of how this was achieved.
Allocation concealment?	Yes	"Patients were allocated randomly to a stocking group or control group by instructions in sealed envelopes."
Blinding? All outcomes	Unclear	No mention of blinding.
Incomplete outcome data addressed? All outcomes	Yes	3/98 patients were not included in the analysis, but were accounted for.
Free of selective reporting?	Yes	Results of all outcomes were reported.

Holford 1976 (*Continued*)

Free of other bias?	Yes	

Hui 1996

Methods	Study: RCT Exclusions post-randomisation: 37 Losses to follow up: 0 DVT diagnosis: phlebography between 5th and 7th day post-operatively. Statistical analysis: Chi^2, Fisher's exact and Student's t test.
Participants	Country: UK Total number of participants: 177 Total available for analysis: 138 Age: >40 years Sex: male and female Inclusion criteria: All patients admitted for total hip or knee replacement. Exclusion criteria: Past history of DVT, peripheral vascular disease, revision of prosthesis or bilateral joint replacements.
Interventions	Type of treatment: GCS thigh and knee length Control (thigh length + knee length): 54 Treatments: 86 Duration applied: applied on the day before surgery and removed after a week.
Outcomes	DVT Control: 30 Treatment: 38 P value: not given
Notes	Analysis of patients was performed between those who received above knee and below knee stockings. Both operated and non-operated legs were analysed separately. Method of randomisation is not clear although it appears appropriate. Incidence of PE and adverse events not mentioned.

Risk of bias

Item	**Authors' judgement**	**Description**
Adequate sequence generation?	Unclear	Method of randomisation not mentioned. Patients were randomised in a ratio of 1:1 in the thigh-length GCS group and 1:4 in the knee-length GCS group.
Allocation concealment?	Unclear	Not mentioned.
Blinding? All outcomes	Unclear	Not mentioned.

Hui 1996 (*Continued*)

Incomplete outcome data addressed? All outcomes	Yes	39/177 patients were not analysed, but were accounted for.
Free of selective reporting?	Yes	Results of all outcomes were reported.
Free of other bias?	Unclear	The control group of the thigh-length GCS group was also used as control for the knee-length GCS group. Partly funded by Brevet Hospital Products who manufacture stockings.

Kalodiki 1996

Methods	Study: RCT Exclusion to post-randomisation: 15 Losses to follow up: 0 DVT diagnosis: venography performed on 8th to 12th post-operative day before discharge. Statistical analysis: Yate's correction
Participants	Country: UK Total number of participants: 93 Total available for analysis: 78 Age: >40 years Sex: male and female Inclusion criteria: patients having unilateral total hip replacement for the first time or without cement under general anaesthesia Exclusion criteria: patients with bleeding disorders/bleeding risks, anticoagulant therapy, NSAIDs/aspirin, cardiovascular disease, renal/hepatic/pancreatic disease, relevant allergies/hypersensitivities.
Interventions	Type of treatment: GCS thigh length Control: 32 Treatment: 32 Duration: stockings applied on both legs before the operation until discharge.
Outcomes	DVT Control: 12 Treatment: 8 P>0.1
Notes	All patients in the treatment and control groups had enoxaparin 40mg 12 hours before the operation, and then once daily until discharge. An additional group of 14 patients who received no prophylaxis (placebo group) was excluded from this review. There was no significant difference in incidence of PE between the two included groups. Control: 3/29 Treatment: 2/31 P value: not significant

Kalodiki 1996 (*Continued*)

	Adverse effects: There were no differences in haemorrhagic complications between the three groups, and no adverse events were recorded.

Risk of bias

Item	Authors' judgement	Description
Adequate sequence generation?	Yes	Patients were assigned consecutive numbers.
Allocation concealment?	Yes	Using sealed envelopes.
Blinding? All outcomes	Yes	"Venograms and V/Q scans were reported blindly by an independent panel of 3 and 1 radiologist respectively."
Incomplete outcome data addressed? All outcomes	Yes	15/93 patients could not be evaluated because 10 declined venography and 5 did not have it for technical reasons
Free of selective reporting?	Yes	Results of all outcome measures were reported.
Free of other bias?	Yes	However, this study was supported by Rhone-Poulenc-Rorer.

Kierkegaard 1993

Methods	Study: RCT Exclusions post-randomisation: 0 Losses to follow up: 0 DVT diagnosis: FUT* on the 2nd day and every 2nd day or every day when the results were positive. Phlebography if positive. Statistical analysis: Fisher exact and two-sided Student's t test.
Participants	Country: Sweden Total number of participants: 80 Total available for analysis: 80 Age: >70 years Sex: male and female Inclusion criteria: all patients with myocardial infarction as defined by Minnesota Code Category 1. Exclusion criteria: none given.
Interventions	Type of treatment: GCS thigh length Control: 80 (opposite non-stockinged leg) Treatment: 80 Duration applied: time of application and duration applied was not given.

Kierkegaard 1993 (*Continued*)

Outcomes	DVT Control: 8 Treatment: 0 P=0.0003
Notes	One limb was randomised to act as control. Aspirin was used in all patients. Incidence of PE not mentioned. Adverse events: post-phlebitic changes.

Risk of bias

Item	Authors' judgement	Description
Adequate sequence generation?	Unclear	Method of randomisation not mentioned.
Allocation concealment?	Unclear	Not mentioned.
Blinding? All outcomes	Unclear	"Results were calculated without knowledge of which leg had stockings and which leg developed a positive fibrinogen uptake test." Comment: insufficient detail.
Incomplete outcome data addressed? All outcomes	Yes	All 80 patients were accounted for and analysed.
Free of selective reporting?	Yes	Results for all outcome measures were reported.
Free of other bias?	Yes	

Ohlund 1983

Methods	Study: RCT Exclusion to post-randomisation: 1 Losses to follow up: 0 DVT diagnosis: FUT* every day for 10 days. Statistical analysis: Student's t test.
Participants	Country: Sweden Total number of participants: 63 Total available for analysis: 62 Age: > 50 years Sex: male and female Inclusion criteria: all patients admitted for elective hip arthroplasty. Exclusion criteria: none mentioned.

Ohlund 1983 (*Continued*)

Interventions	Type of treatment: GCS length not stated Control: 31 Treatment: 31 Duration: not mentioned.
Outcomes	DVT Control: 15 Treatment: 7 P<0.05
Notes	All had Dextran 70 infusion at induction of anaesthesia and 2 days following operation. Dose: 500 ml per day. Incidence of PE and adverse events not mentioned.

Risk of bias

Item	Authors' judgement	Description
Adequate sequence generation?	Unclear	Method of randomisation not mentioned.
Allocation concealment?	Unclear	Not mentioned.
Blinding? All outcomes	Unclear	Not mentioned.
Incomplete outcome data addressed? All outcomes	Yes	1/63 patients was not analysed, but was accounted for.
Free of selective reporting?	Yes	Results of all outcome measures were reported.
Free of other bias?	Yes	However, stockings were supplied by AKLA AB.

Scurr 1977

Methods	Study: RCT Exclusion to post-randomisation: 5 Losses to follow up: 0 DVT diagnosis: FUT * on 1st, 2nd, 3rd, 5th and 7th post-operative days. Statistical analysis: Fisher's exact test.
Participants	Country: UK Total number of participants: 75 Total available for analysis: 70 Age: >42 years Sex: male and female Inclusion criteria: all patients admitted for major abdominal surgery. Exclusion criteria: none mentioned.

Scurr 1977 (*Continued*)

Interventions	Type of treatment: GCS thigh length. Control: 70 (32 right leg, 38 left leg) Treatment: 70 (38 right leg, 32 left leg) Duration: wore the stockings on the evening before the operation until the 9th post-operative day.
Outcomes	DVT Control: 26 Treatment: 8 P<0.0003
Notes	Incidence of PE and adverse events was not mentioned.

Risk of bias

Item	**Authors' judgement**	**Description**
Adequate sequence generation?	Yes	By "tossing a coin".
Allocation concealment?	Unclear	Not mentioned.
Blinding? All outcomes	Unclear	Not mentioned.
Incomplete outcome data addressed? All outcomes	Yes	5/75 patients were not analysed, but were accounted for.
Free of selective reporting?	Yes	Results of all outcome measures were reported.
Free of other bias?	Yes	However, stockings for this study were supplied by Kendall Co.

Scurr 1987

Methods	Study: RCT Exclusions post-randomisation: 0 Losses to follow up: 0 DVT diagnosis: FUT * on 1st, 3rd, 5th and 7th post operative day and phlebography if FUT was positive. Statistical analysis: McNemar's exact test.
Participants	Country: UK Total number of participants: 78 Total available for analysis: 78 Age: >43 years Sex: male and female Inclusion criteria: all patients admitted for abdominal operations. Exclusion criteria: anyone with pre-operative evidence of DVT on Doppler ultrasound

Scurr 1987 (*Continued*)

	and strain-gauge plethysmography methods.
Interventions	Type of treatment: GCS thigh length Control: 78 (legs, sequential compression device only) Treatment: 78 (legs, sequential compression device and GCS) Duration: until ambulatory.
Outcomes	DVT Control: 7 Treatment: 1 P<0.016
Notes	Left and right legs were randomised to receive treatment or control. The control group had only a sequential compression device fitted on the day of the operation. The treatment group had both GCS and sequential compression devices fitted. Incidence of PE and adverse events were not mentioned.

Risk of bias

Item	Authors' judgement	Description
Adequate sequence generation?	Unclear	Method of randomisation not mentioned.
Allocation concealment?	Unclear	Not mentioned.
Blinding? All outcomes	Unclear	Not mentioned.
Incomplete outcome data addressed? All outcomes	Yes	All 78 patients accounted were for.
Free of selective reporting?	Yes	Results of all outcome measures were reported.
Free of other bias?	Yes	However, the study was supported in part by the Kendall Research Centre.

Shirai 1985

Methods	Study: RCT Losses to follow up: not reported DVT diagnosis: fibrogen uptake test and measurement of leg diameter pre-operatively, immediately after surgery, and on post-operative days 1, 3, 5, and 7. Statistical analysis: ?
Participants	Country: Japan Total number of participants: 126 Total available for analysis: 126 Age: 18-81 years (Mean 54.8 years) Sex: male and female

Shirai 1985 (*Continued*)

	Inclusion criteria: heart surgery and vein surgery patients. Exclusion criteria: complications with swellings on the veins of the legs, and previous history of venous thrombosis in the legs.
Interventions	Type of treatment: thigh-length GCS Control: 126 (legs with stockings) Treatment: 126 (legs without stockings) Duration: not mentioned.
Outcomes	DVT Control: 17 Treatment: 5 P<0.01
Notes	This trial was published in Japanese which made it difficult to extract information about the methodology accurately.

Risk of bias

Item	Authors' judgement	Description
Adequate sequence generation?	Unclear	Method of randomisation not stated.
Allocation concealment?	No	
Blinding? All outcomes	No	
Incomplete outcome data addressed? All outcomes	Unclear	Japanese study, difficult to determine.
Free of selective reporting?	Unclear	Japanese study, difficult to determine.
Free of other bias?	Unclear	Japanese study, difficult to determine.

Torngern 1980

Methods	Study: RCT Exclusions post-randomisation: 12 Losses to follow up: 0 DVT diagnosis: FUT * started the day before the operation up to the 7th day. Statistical analysis: Sign test
Participants	Country: Sweden Total number of participants: 110 Total available for analysis: 98 Age: > 42 years Sex: male and female Inclusion criteria: all patients admitted for major abdominal operation.

Torngern 1980 (*Continued*)

	Exclusion criteria: those positive for pre-operative FUT.
Interventions	Type of treatment: GCS thigh length Control: 98 Treatment: 98 Duration: GCS applied the day of the operation and continued 6th post-operative day.
Outcomes	DVT Control: 12 Treatment: 4 P<0.004
Notes	All patients had heparin 5000 iu 12 hourly. None of the patients developed PE or reported side-effects.

Risk of bias

Item	Authors' judgement	Description
Adequate sequence generation?	No	Randomisation was achieved "...depending on the date of birth of the patient".
Allocation concealment?	Unclear	Not mentioned.
Blinding? All outcomes	Unclear	Not mentioned.
Incomplete outcome data addressed? All outcomes	Yes	12/110 patients were excluded from analysis, but were accounted for.
Free of selective reporting?	Yes	Frequency of DVT in both groups was reported.
Free of other bias?	Yes	

Tsapogas 1971

Methods	Study: RCT Exclusions post-randomisation: 0 Losses to follow up: 0 DVT diagnosis: FUT* on 1st, 3rd, 5th and 7th day. Phlebogram at the end of 1 week. Statistical analysis: not given.
Participants	Country: USA Total number of participants: 95 Total available for analysis: 95 Age: >40 years Sex: both Inclusion criteria: all major abdominal surgery and those who were negative to pre-

Tsapogas 1971 (*Continued*)

	operative phlebography. Exclusion criteria: lower limb operations, thyroid diseases.
Interventions	Type of treatment: GCS thigh length Control: 44 Treatment: 51 Duration: wore stockings on the day of surgery until discharge.
Outcomes	DVT Control: 6 Treatment: 2 P value: not given
Notes	Numbers in each group calls into question if this was properly randomised. Incidence of PE and adverse events were not mentioned.

Risk of bias

Item	**Authors' judgement**	**Description**
Adequate sequence generation?	Yes	By a random allocation table.
Allocation concealment?	Unclear	Not mentioned. However, discrepancy between the number of patients randomised to the treatment and control groups.
Blinding? All outcomes	Unclear	Not mentioned.
Incomplete outcome data addressed? All outcomes	Yes	All 95 patients were accounted for and analysed.
Free of selective reporting?	Yes	Results of all outcome measures were reported.
Free of other bias?	Unclear	Patients in the treatment group were given extra recommendations regarding exercise which were not given to patients in the control group, also received stockings.

Turner 1984

Methods	Study: RCT Exclusions post-randomisation: 0 Losses to follow up: 0 DVT diagnosis: FUT * Statistical analysis: Fisher exact test.
Participants	Country: UK Total number of participants: 196 Total available for analysis: 196 Age: >35 years Sex: female Inclusion criteria: all patients admitted for elective gynaecological surgery. Exclusion criteria: malignancy, diabetes, pregnancy, DVT, anticoagulation treatment.
Interventions	Type of treatment: GCS length not stated. Control: 92 Treatment: 104 Duration: GCS fitted on the day of admission. When it was discontinued is not mentioned.
Outcomes	DVT Control: 4 Treatment: 0 P=0.048
Notes	Although randomised, method not made explicit. Losses to follow up, or loss to randomisation not made explicit. Incidence of PE and adverse events were not mentioned.

Risk of bias

Item	**Authors' judgement**	**Description**
Adequate sequence generation?	Yes	Random number chart was used.
Allocation concealment?	Unclear	Not mentioned.
Blinding? All outcomes	Yes	"The scans were assessed blindly".
Incomplete outcome data addressed? All outcomes	Yes	All 196 patients who entered the study were analysed and accounted for.
Free of selective reporting?	Yes	Results of all outcome measures were reported.
Free of other bias?	Yes	However, stockings were supplied by Kendall Co.

Turpie 1989

Methods	Study: RCT Exclusions post-randomisation: 0 Losses to follow up: 0 DVT diagnosis: FUT * daily for 14 days or till discharge. IPG before study and day 3, 5, 7, 9, 11 and 14 days or on the day of discharge. If FUT or IPG was abnormal phlebogram was carried out. Statistical analysis: Fisher exact or one-sided Chi^2.
Participants	Country: USA Total no of Participants: 239 Total available for analysis: 239 Age: >16 years Sex: male and female Inclusion criteria: all patients with head or spinal pathology including trauma. Exclusion criteria: history of iodine allergy, trauma to legs, mild head injury that needed only 24 hour surgery, those that needed anticoagulant treatment, or initial abnormal IPG.
Interventions	Type of treatment: GCS thigh length (one had knee length because of obesity) Control: 81 Treatment: 80 Duration: applied 12 hours before surgery, and removed after patient fully mobile (4 to 5 days later). Patients encouraged to mobilise early.
Outcomes	DVT Control: 16 Treatment: 7 P=0.023
Notes	Losses to follow up: 1, dead: 19 (none due to PE). It is not explicit if these patients were included or excluded in the study. 1 patient developed PE.

Risk of bias

Item	**Authors' judgement**	**Description**
Adequate sequence generation?	Unclear	By "...a prescribed randomised arrangement".
Allocation concealment?	Yes	"Using sealed envelopes".
Blinding? All outcomes	Yes	"The results of the tests were interpreted independently by a panel of experts blinded to the patient's treatment group."
Incomplete outcome data addressed? All outcomes	Yes	All 236 patients accounted for.

Turpie 1989 (*Continued*)

Free of selective reporting?	Yes	Results of all outcomes measures were reported.
Free of other bias?	Yes	

Wille-Jorgensen 1985

Methods	Study: RCT Exclusions post-randomisation: 20 Losses to follow up: 0 DVT diagnosis: FUT pre-operatively and on 1st, 3rd, 5th and 7th day post-operatively. Those who are FUT positive also had phlebography and perfusion lung scan. Statistical analysis: Mann-Whitney U test.
Participants	Country: Denmark Total number of participants: 196 Total available for analysis: 176 Age: >39 years Sex: male and female Inclusion criteria: all patients for abdominal surgery. Exclusion criteria: those with hepatic diseases with coagulation defects, anticoagulant treatment, peripheral arterial diseases, and allergy to iodine.
Interventions	Treatment: GCS thigh length Control: 90 Treatment: 86 Duration: GCS was fitted on the day of surgery and continued for 7 days or until discharge.
Outcomes	DVT Control: 7 Treatment: 1 P<0.05 PE Control: 6 Treatment: 2 P value: not significant
Notes	Heparin 5000 iu was given to all patients every 12 hourly for 7 days or until discharge. Thromboembolic complications are not clear. No mention of adverse events.

Risk of bias

Item	**Authors' judgement**	**Description**
Adequate sequence generation?	Yes	"by random numbers".

Wille-Jorgensen 1985 (*Continued*)

Allocation concealment?	Unclear	Not mentioned.
Blinding? All outcomes	Yes	"Phlebogram evaluated by radiologist not aware of the patient's treatment group" and scintigraphy "read blindly".
Incomplete outcome data addressed? All outcomes	Yes	20/196 patients withdrew, but all were accounted for.
Free of selective reporting?	Yes	Results of all outcome measures were addressed.
Free of other bias?	Yes	However, heparin and thrombograph was supplied by Novo Diagnostics and Kendall supplied the stockings.

Wille-Jorgensen 1991

Methods	Study: RCT Exclusions post-randomisation: 31 Losses to follow up: 0 DVT diagnosis: FUT on the 1st, 3rd, 5th and 7th post-operative days and phlebography as indicated. Statistical analysis: Kruskall-Wallis test, Chi^2 test, and Mantle-Haenszel test.
Participants	Country: Denmark Total number of participants: 276 Total available for analysis: 245 Age: > 39 Sex: male and female Inclusion criteria: all patients admitted for abdominal operations lasting over 1 hour. Exclusion criteria: allergy to iodine, dextran. Severe peripheral vascular disease, pregnancy, GI bleeding.
Interventions	Type of treatment: GCS length not stated Control: 81 Treatment: 79 Duration: worn until full mobilisation.
Outcomes	DVT Control: 12 Treatment: 2 P<0.013
Notes	On a background of heparin 5000 iu prophylaxis. One group received Dextran and TED, which is excluded in our analysis. Incidence of PE not mentioned. Adverse events: bleeding complications.

Wille-Jorgensen 1991 (*Continued*)

Risk of bias		
Item	**Authors' judgement**	**Description**
Adequate sequence generation?	Yes	"continuous random numbers".
Allocation concealment?	Yes	Sealed envelopes were used.
Blinding? All outcomes	Unclear	Not mentioned.
Incomplete outcome data addressed? All outcomes	Yes	31 patients withdrew, but were all accounted for.
Free of selective reporting?	Yes	Results of all outcome measures were reported.
Free of other bias?	Yes	

* FUT - 125-I fibrinogen uptake test. A sustained difference of more than 20% between consecutive or opposite points or a raising count were considered diagnostic of DVT.
^ IPG - Intermittent pneumatic compression device.
# GCS - Graduated compression stockings also called TED stockings -- thrombo-embolic deterrent stockings. Compression is graduated, 18 mm Hg, 14 mm Hg, 8 mm Hg, 10 mm Hg and 8 mm Hg from ankle to upper thigh. Manufactured by Kendall Company.
~ Pharmacia AB, Uppsala, Sweden.
¬ TED Comprinet S Reg/ BDF Hamburg-West Germany.

Characteristics of excluded studies *[ordered by study ID]*

Study	Reason for exclusion
Belcaro 1993	Method is not very clear with regard to randomisation. The cause of dropouts is not clear. The duration for which the stockings were worn is not mentioned. Medical or surgical need for admission of these patients is not clear. Method of monitoring the occurrence of DVT in the study is unclear.
Benko 2001a	Incidence of DVT not assessed. Measures venous flow.
Bolton 1978	Not randomised and not published as a paper. High risk group of patients were involved (malignant diseases) . A significant reduction in DVT was noted in the treatment group compared with the control group. The method of analysis seems appropriate.
Borow 1983	Both patients and controls were assigned to the study on a rotation basis. Not randomised.

(*Continued*)

Brunkwall 1991	Not published as a full paper. Abstract does not mention number of legs in each group (transplanted side versus non-transplanted side).
Caprini 1983	Control group is retrospective.
Chandhoke 1991	Lacks appropriate control group. Compares patients given coumadin only to those given compression stockings only.
CLOTS 2009	Included only stroke patients. It was decided that this trial would better suit a systematic review conducted by the Stroke Group (Mazzone 2004).
Cohen 2007	Asymptomatic DVT seem to have only been assessed proximally, as incidence of distal asymptomatic DVT was not reported. Proximal asymptomatic DVT was diagnosed using venography, however it was unclear whether symptomatic DVT was also confirmed objectively using this method, and whether this was standardised throughout the study.
Fasting 1985	Lacks appropriate control group. Compares patients given heparin only to those given compression stockings only.
Flanc 1969	Thick elastic compression stockings used not TED. This study was randomised and would have been suitable for analysis.
Hansberry 1991	Lacks appropriate control group. Three groups - thromboembolic stocking only versus external sequential pneumatic compression stockings only versus heparin+dihydroergotamine.
Ibarra-Perez 1988	Not randomised.
Ibegbuna 1997	Incidence of DVT not assessed. Studies venous haemodynamics.
Inada 1983	Good study but not randomised prospectively.
Ishak 1981	Study not randomised.
KANT study	Lacks appropriate control group. Compares three groups - stockings only versus LMWH 7-days versus LMWH 14-days.
Koopmann 1985	Lacks appropriate control group. Compares patients given heparin only to those given stockings only.
Lacut 2005	All patients wore elastic compression stockings (stockings only versus stockings + intermittent pneumatic compression). Therefore, lacks appropriate control group.
Lee 1989	Compares three groups sodium heparin versus calcium heparin versus stockings. Lacks appropriate control group.
Lewis 1976	Incidence of DVT not assessed. Analyses venous clearance.
Liavag 1972	Not randomised.

(*Continued*)

Maksimovic 1996	All patients wore stockings. GCS+standard heparin versus GCS+dipyridamole+acetylsalicylic acid versus GCS+placebo. Lacks appropriate control group.
Manella 1981	Incidence of DVT not assessed. Measures residual limb volume.
Marescaux 1981	Not an RCT.
Marston 1995	All patients wore stockings. Compares LMWH+stockings versus stockings alone. Lacks appropriate control group.
Mellbring 1986	Not amenable to analysis as the figures are difficult to interpret.
Moser 1976	Not randomised.
Moser 1980	A sequential compression device was used, not graduated compression stockings. Compares two groups - heparin + dihydroergot versus physiotherapy (IPCS + physical exercise).
Muir 2000	This is a randomised controlled trial but very poorly conducted. They have compared two types of stockings with the same control group, which is inappropriate. There is a great deal of discrepancy in the number of patients in each group for an adequate RCT. Also, this trial included stroke patients, making it better suited to a similar review conducted by the Stroke Group (Mazzone 2004).
Nelson 1996	All patients wore stockings. Compares two groups - TED+aspirin versus TED+aspirin+pneumatic compression stockings.
Norgren 1996	Compares patients wearing IPCS+GCS to patients on enoxaparin, rather than to a control group of patients wearing intermittent pneumatic compression stockings only.
Nurmohamed 1996	All patients wore stockings. Compares patients wearing stockings and taking nandroparin versus patients wearing stockings alone, rather than a control group of patients not wearing stockings and on nandroparin as background prophylaxis.
Patel 1988	Antithrombotic stockings but does not state compression graduated stockings. French paper.
Perkins 1999	Not published as a full paper, therefore difficult to analyse.
Pitto 2008	Not adequately randomised.
Porteous 1989	This study compared above knee stockings with below knee stockings, rather than to a control group of no stockings or another method of prophylaxis.
Ramos 1996	This study used pneumatic compression stockings rather than graduated compression stockings.
Rasmussen 1988	This study solely relied on the Tc^{99m} plasmin test which is associated with high frequency of false positives. Diagnosis of DVT was not confirmed using another objective test. Furthermore, the method of randomisation used in this trial does not appear to be reliable, due to substantial difference in number of patients allocated to the GCS only group (74 patients) and GCS+heparin group (89 patients).

(*Continued*)

Rohrer 1996	Review paper.
Rosengarten 1970	This trial used Tubigrip rather than graduated compression stockings.
Ryan 2002	This study compared two groups - mechanical compression+aspirin versus GCS+aspirin. Lacks a control group with patients on aspirin with no stockings.
Scholz 1979	Review paper published as a book chapter.
Silbersack 2004	This study compared two groups - LMWH + IPC versus LMWH + GCS. Lacks a control group of patients on LMWH with no stockings.
Westrich 1996	This study used a pneumatic plantar compression device rather than graduated compression stockings.
Wilkins 1952	Based solely on clinical diagnosis of DVT instead of using doppler/venography for confirmation, as set out in the criteria for this review.
Wilson 1994	Studies venous haemodynamics. Does not assess the incidence of DVT.

Characteristics of studies awaiting assessment *[ordered by study ID]*

Celebi 2001

Methods	Study: RCT Losses to follow up: 2 patients in control group died during treatment DVT diagnosis: deep venous Doppler ultrasonography (DUSG) PE diagnosis: pulmonary scintigraphy
Participants	Country: Turkey Total no. of participants: 274 Total available for analysis: 274 Sex: male and female Inclusion criteria: patients undergoing major abdominal surgery
Interventions	Type of treatment: compression stockings Control: 91 (LMWH only) Treatment: 92 (LMWH and compression stockings) Duration: not specified in abstract
Outcomes	DVT Control: 8 Treament: 3 P>0.05 (not significant)
Notes	Turkish paper. Low molecular weight heparin (nadroparine calcium 0.3ml 2850 IU AXa) was given to both control and treatment

Celebi 2001 (*Continued*)

	groups. This study included an additional group of patients who wore stockings but did not take LMWH. However, this group was not appropriate for this review.

Wille-Jorgensen 1986

Methods	Study: RCT DVT diagnosis: 125-I fibrinogen scanning. If positive, phlebography undertaken
Participants	Total no. of participants: 131 Inclusion criteria: patients undergoing elective colo-rectal surgery
Interventions	Type of treatment: graduated supportive stockings
Outcomes	(not specified in the abstract)
Notes	Danish paper. English abstract does not specify the number of patients included in the series of patients investigating the effect of combination of LMWH and GCS. Exact figures not specified in the abstract.

DATA AND ANALYSES

Comparison 1. Incidence of DVT in Group 1: with stockings and without stockings

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 All Specialties	8	1279	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.35 [0.26, 0.47]
1.1 General Surgery	4	530	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.30 [0.20, 0.45]
1.2 Orthopaedic Surgery	1	140	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.64 [0.32, 1.25]
1.3 Other Specialties	3	609	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.32 [0.18, 0.58]

Comparison 2. Incidence of DVT in Group 2: with stockings and without stockings on a background of additional antithrombotic measures

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 All Specialties	10	1248	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.25 [0.17, 0.36]
1.1 General Surgery	5	848	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.23 [0.13, 0.39]
1.2 Orthopaedic Surgery	4	240	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.31 [0.17, 0.55]
1.3 Other Specialties	1	160	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.12 [0.03, 0.51]

Comparison 3. Pulmonary embolism

Outcome or subgroup title	No. of studies	No. of participants	Statistical method	Effect size
1 Group 1: With stockings and without stockings	1		Peto Odds Ratio (Peto, Fixed, 95% CI)	Totals not selected
2 Group 2: With stockings and without stockings on a background of additional antithrombotic measures	3	254	Peto Odds Ratio (Peto, Fixed, 95% CI)	0.36 [0.13, 0.99]

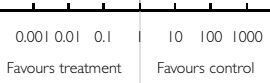
Analysis 1.1. Comparison 1 Incidence of DVT in Group 1: with stockings and without stockings, Outcome 1 All Specialties.

Review: Elastic compression stockings for prevention of deep vein thrombosis

Comparison: 1 Incidence of DVT in Group 1: with stockings and without stockings

Outcome: 1 All Specialties

Study or subgroup	Treatment n/N	Control n/N	Peto Odds Ratio Peto,Fixed,95% CI	Weight	Peto Odds Ratio Peto,Fixed,95% CI
1 General Surgery					
Allan 1983	15/97	37/103		22.4 %	0.35 [0.18, 0.65]
Holford 1976	11/48	23/47		12.8 %	0.33 [0.14, 0.75]
Scurr 1977	8/70	28/70		15.6 %	0.23 [0.11, 0.48]
Tsapogas 1971	2/51	6/44		4.3 %	0.29 [0.07, 1.22]
Subtotal (95% CI)	**266**	**264**		**55.1 %**	**0.30 [0.20, 0.45]**
Total events: 36 (Treatment), 94 (Control)					
Heterogeneity: Chi^2 = 0.78, df = 3 (P = 0.85); I^2 =0.0%					
Test for overall effect: Z = 5.89 (P < 0.00001)					
2 Orthopaedic Surgery					
Hui 1996	38/86	30/54		19.4 %	0.64 [0.32, 1.25]
Subtotal (95% CI)	**86**	**54**		**19.4 %**	**0.64 [0.32, 1.25]**
Total events: 38 (Treatment), 30 (Control)					
Heterogeneity: not applicable					
Test for overall effect: Z = 1.31 (P = 0.19)					
3 Other Specialties					
Shirai 1985	5/126	17/126		11.7 %	0.30 [0.13, 0.73]
Turner 1984	0/104	4/92		2.3 %	0.11 [0.02, 0.83]
Turpie 1989	7/80	16/81		11.5 %	0.41 [0.17, 0.99]
Subtotal (95% CI)	**310**	**299**		**25.5 %**	**0.32 [0.18, 0.58]**
Total events: 12 (Treatment), 37 (Control)					
Heterogeneity: Chi^2 = 1.34, df = 2 (P = 0.51); I^2 =0.0%					
Test for overall effect: Z = 3.79 (P = 0.00015)					
Total (95% CI)	**662**	**617**		**100.0 %**	**0.35 [0.26, 0.47]**
Total events: 86 (Treatment), 161 (Control)					
Heterogeneity: Chi^2 = 5.80, df = 7 (P = 0.56); I^2 =0.0%					
Test for overall effect: Z = 6.86 (P < 0.00001)					
Test for subgroup differences: Chi^2 = 3.67, df = 2 (P = 0.16), I^2 =46%					



Analysis 2.1. Comparison 2 Incidence of DVT in Group 2: with stockings and without stockings on a background of additional antithrombotic measures, Outcome 1 All Specialties.

Review: Elastic compression stockings for prevention of deep vein thrombosis

Comparison: 2 Incidence of DVT in Group 2: with stockings and without stockings on a background of additional antithrombotic measures

Outcome: 1 All Specialties

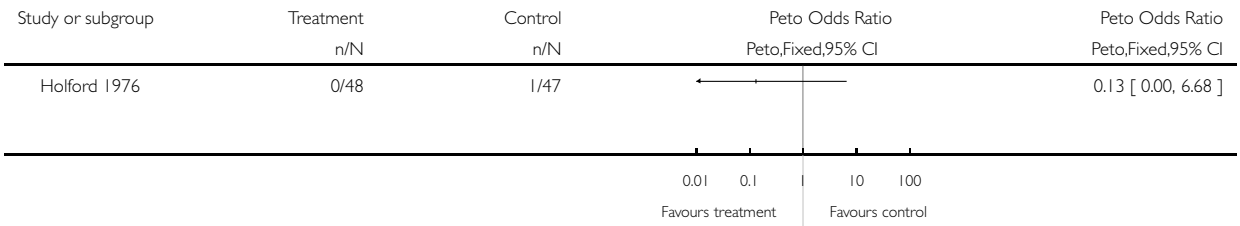
Study or subgroup	Treatment n/N	Control n/N	Peto Odds Ratio Peto,Fixed,95% CI	Weight	Peto Odds Ratio Peto,Fixed,95% CI
1 General Surgery					
Bergqvist 1984	0/80	8/80		7.4 %	0.12 [0.03, 0.51]
Scurr 1987	1/78	7/78		7.4 %	0.21 [0.05, 0.86]
Torngern 1980	4/98	12/98		14.2 %	0.34 [0.12, 0.94]
Wille-Jorgensen 1985	1/86	7/90		7.4 %	0.22 [0.05, 0.90]
Wille-Jorgensen 1991	2/79	12/81		12.4 %	0.22 [0.07, 0.65]
Subtotal (95% CI)	**421**	**427**		**48.7 %**	**0.23 [0.13, 0.39]**
Total events: 8 (Treatment), 46 (Control)					
Heterogeneity: Chi^2 = 1.32, df = 4 (P = 0.86); I^2 =0.0%					
Test for overall effect: Z = 5.29 (P < 0.00001)					
2 Orthopaedic Surgery					
Barnes 1978	0/8	5/10		3.6 %	0.10 [0.01, 0.71]
Fredin 1989	3/49	13/47		13.0 %	0.22 [0.07, 0.63]
Kalodiki 1996	8/32	12/32		13.4 %	0.56 [0.20, 1.61]
Ohlund 1983	7/31	15/31		13.9 %	0.33 [0.12, 0.93]
Subtotal (95% CI)	**120**	**120**		**43.9 %**	**0.31 [0.17, 0.55]**
Total events: 18 (Treatment), 45 (Control)					
Heterogeneity: Chi^2 = 3.03, df = 3 (P = 0.39); I^2 =1%					
Test for overall effect: Z = 3.96 (P = 0.000074)					
3 Other Specialties					
Kierkegaard 1993	0/80	8/80		7.4 %	0.12 [0.03, 0.51]
Subtotal (95% CI)	**80**	**80**		**7.4 %**	**0.12 [0.03, 0.51]**
Total events: 0 (Treatment), 8 (Control)					
Heterogeneity: not applicable					
Test for overall effect: Z = 2.89 (P = 0.0038)					
Total (95% CI)	**621**	**627**		**100.0 %**	**0.25 [0.17, 0.36]**
Total events: 26 (Treatment), 99 (Control)					
Heterogeneity: Chi^2 = 5.95, df = 9 (P = 0.74); I^2 =0.0%					
Test for overall effect: Z = 7.11 (P < 0.00001)					
Test for subgroup differences: Chi^2 = 1.60, df = 2 (P = 0.45), I^2 =0.0%					

Analysis 3.1. Comparison 3 Pulmonary embolism, Outcome 1 Group 1: With stockings and without stockings.

Review: Elastic compression stockings for prevention of deep vein thrombosis

Comparison: 3 Pulmonary embolism

Outcome: 1 Group 1: With stockings and without stockings

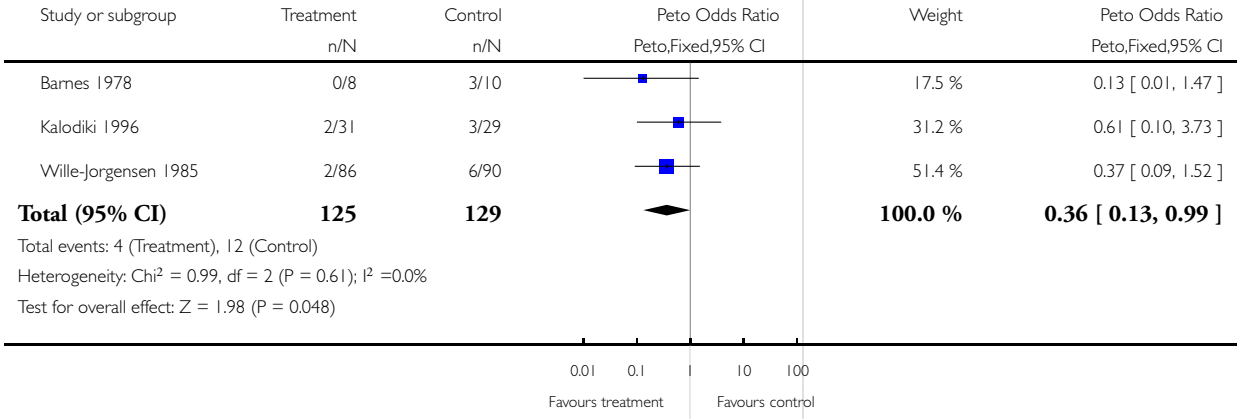


Analysis 3.2. Comparison 3 Pulmonary embolism, Outcome 2 Group 2: With stockings and without stockings on a background of additional antithrombotic measures.

Review: Elastic compression stockings for prevention of deep vein thrombosis

Comparison: 3 Pulmonary embolism

Outcome: 2 Group 2: With stockings and without stockings on a background of additional antithrombotic measures



APPENDICES

Appendix 1. Search strategies for the Cochrane Central Register of Controlled Trials (CENTRAL)

2010 Update
#1 MeSH descriptor Venous Thrombosis explode all trees
#2 MeSH descriptor Thromboembolism explode all trees
#3 MeSH descriptor Thrombosis, this term only
#4 thromboprophyla* or thrombus* or thrombotic* or thrombolic* or thromboemboli* or thrombos* or embol*
#5 dvt* or PE
#6 (#1 OR #2 OR #3 OR #4 OR #5)
#7 MeSH descriptor Stockings, Compression explode all trees
#8 stocking* or hosiery* or tights* or sock* or bandage* or compres*
#9 MeSH descriptor Bandages, this term only
#10 (#7 OR #8 OR #9)
#11 (#6 AND #10)

2003 Version
1. THROMBOEMBOLISM explode all trees (MeSH)
2. thromboembolism
3. (deep next vein next thrombosis)
4. (deep next venous next thrombosis)
5. (#1 or #2 or #3 or #4)
6. PULMONARY EMBOLISM single term (MeSH)
7. (pulmonary next embolism)
8. EMBOLISM AND THROMBOSIS explode tree 1 (MeSH)
9. (#6 or #7 or #8)
10. (#5 or #9)
11. (elastic next compression next stockings)
12. (graduated next compression next stockings)
13. (#11 or #12)
14. (#10 and #13)

Appendix 2. Search terms used to search specialised register

{Compression stocking} OR {Compression} OR {Stockings} OR {Knee high stockings} OR {TED*} OR {graduated*} OR {Elastic compression*} OR {Elastic shrinker socks} OR {elastic stockings*} OR {Tubigrip} OR {Travel socks}

WHAT'S NEW

Last assessed as up-to-date: 18 April 2010.

Date	Event	Description
10 May 2010	New citation required but conclusions have not changed	Two new authors updated the review.
15 March 2010	New search has been performed	The review was updated and two additional trials were added to the included studies. Thirty-five additional trials were added to the excluded studies.

HISTORY

Protocol first published: Issue 2, 1999

Review first published: Issue 3, 2000

Date	Event	Description
8 September 2008	Amended	Converted to new review format.
15 February 2008	Feedback has been incorporated	An interim response added to feedback to say that the review is in the process of being updated. The authors intend to address the comments and provide a full response with the update.
26 November 2003	New search has been performed	Four additional trials added to excluded studies.

CONTRIBUTIONS OF AUTHORS

Ashwin Sachdeva (AS): selected trials for inclusion; assessed quality of trials; extracted data; updated review.

Mark Dalton (MJD): selected trials for inclusion; assessed quality of trials; updated review.

Sachi Amaragiri (SVA): selected trials for inclusion; assessed quality of trials, checked the updated review.

Timothy Lees (TAL): rechecked and authenticated the selected trials for inclusion; assessed quality of trials; cross-checked data, checked the updated review.

DECLARATIONS OF INTEREST

None known

SOURCES OF SUPPORT

Internal sources

- No sources of support supplied

External sources

- Chief Scientist Office, Scottish Government Health Directorates, The Scottish Government, UK.

DIFFERENCES BETWEEN PROTOCOL AND REVIEW

Two trials including stroke patients were excluded from this review (CLOTS 2009; Muir 2000) as they are the subject of another review undertaken by the Stroke group (Mazzone 2004).

INDEX TERMS

Medical Subject Headings (MeSH)

*Stockings, Compression; Hospitalization; Postoperative Complications [prevention & control]; Randomized Controlled Trials as Topic; Venous Thrombosis [*prevention & control]

MeSH check words

Humans