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Decompressive surgery for treating nerve damage in leprosy. A Cochrane review

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Summary

Objective Decompressive surgery is used for treating nerve damage in leprosy. We assessed the effectiveness of decompressive surgery for patients with nerve damage due to leprosy.

Methods A broad search strategy was performed to find eligible studies, selecting randomised controlled trials (RCTs) comparing decompressive surgery alone or plus corticosteroids with corticosteroids alone, placebo or no treatment. Two authors independently assessed quality and extracted data. Where it was not possible to perform a meta-analysis, the data for each trial was summarised.

Results We included two randomised controlled trials involving 88 people. The trials examined the added benefit of surgery over prednisolone for treatment of nerve damage of less than 6 months duration. After 2 years follow-up there was no significant difference in nerve function improvement between people treated with surgery plus prednisolone or with prednisolone alone. Adverse effects of decompression surgery were not adequately described.

Conclusions Evidence from randomised controlled trials does not show a significant added benefit of surgery over steroid treatment alone. Well-designed randomised controlled trials are needed to establish the effectiveness of the combination of surgery and medical treatment compared to medical treatment alone.

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Introduction

This paper is based on a Cochrane review first published in The Cochrane Library 2009, Issue 1 (*see* http://www.thecochranelibrary.com/ for information). *Cochrane reviews are regularly updated as new evidence emerges and in response to feedback, and The Cochrane Library should be consulted for the most recent version of the review*.

Decompressive surgery or neurolysis as treatment for nerve damage has been done for several decennia. The objective of this surgery is to relieve mechanical compression, due to oedema caused by neuritis, of the affected nerve. Decompression is done by incision of the thickened nerve sheath (epineurium) where the nerve is enlarged and often tender on palpation. This incision is often of a considerable length at the place before entering the fibro-osseous tunnel which, during surgery, needs to be opened as well. Results of surgery from non-randomised studies have been widely published.[1–7] Decompressive surgery is not recommended without medical treatment. Indications for surgery are mainly based on common practice but not well defined. These may include the presence of nerve abscess, nerve pain or nerve function impairment that does not respond to medical treatment.[8–12]

Decompressive surgery is frequently used for treating nerve damage in leprosy. The effect of surgery, especially in the long term, is uncertain and it is unclear whether surgery is more beneficial than medical treatment alone. While this review focused on evidence from randomised controlled trials (RCTs), it was expected that only a few RCTs had been conducted in this area. Therefore, the results were also considered in the light of non-randomised evidence in the Discussion section.

Methods

SEARCH STRATEGY

We searched the Cochrane Neuromuscular Disease Group Trials Register (November 2007) using the following terms: leprosy or Hansen disease and decompression or neurolysis or epicondylectomy or epineurotomy or neuritis or nerve damage or nerve loss or nerve function impairment or neuropath* or nerve problem or nerve involvement or nerve pain. This search strategy, combined with a search strategy for identifying randomised trials, was adapted to include additional search terms where necessary and was modified to search the Cochrane Central Register of Controlled Trials in *The Cochrane Library* (Issue 4, 2007); MEDLINE (from January 1950 to November 2007) and EMBASE (from January 1980 to November 2007); AMED (Allied and Complementary Medicine, from January 1985 to November 2007), CINAHL (from January 1982 to November 2007), and LILACS (Latin American and Caribbean Health Science Information database, from January 1982 to November 2007). We checked reference lists of the studies identified, the Current Controlled Trials Register (www.controlled-trials.com), conference proceedings and contacted trial authors. There were no language restrictions. Two authors independently screened the titles and abstracts of all the publications identified to examine whether studies were eligible.

STUDY SELECTION

Studies were eligible if they were (quasi-) randomised controlled trials (RCTs) assessing decompressive surgery versus corticosteroids, placebo or no treatment for patients with

leprosy and related nerve damage. Nerve damage or nerve function impairment (NFI) was defined as clinically detectable impairment of motor or sensory nerve function. It did not include impairment of nerve conduction that was only detectable by electrophysiological means.[13] Outcome measures of interest were: improvement in sensory nerve function as measured with graded nylon filaments[14] or a ball-point pen after 1 or 2 years, improvement in motor nerve function, assessed with the modified MRC grading scale[15] after 1 or 2 years, change in nerve pain and tenderness after 1 year, changes in quality of life, and adverse events.

METHODOLOGICAL QUALITY

The methodological quality of the included studies was based on the following criteria: concealment of allocation; blinding of participants and outcome assessors; loss to follow-up; baseline differences and explicit outcome measures mentioned. Each criterion was assessed as A: adequate, B: unclear or C: inadequate. If one of the criteria was not described in the study, it was labelled 'inadequate'. Two authors independently assessed the included studies for methodological quality.

DATA EXTRACTION AND ANALYSIS

Two authors extracted data regarding methodology and outcome measures from the included studies onto a data extraction form. If there were missing data, the trial authors were contacted. Authors were not blinded to trial author, journal or institution. We used the Cochrane statistical package, Review Manager, for statistical data analysis. Results were expressed as mean differences with 95% confidence intervals (CI) for continuous outcome measures and relative risks (RR) with 95% CI for dichotomous outcomes. In case of clinical heterogeneity, or if data were lacking, the results for each trial were summarised.

Results

STUDY SELECTION

We identified 10 potentially relevant studies and excluded seven, because they were not randomised. Two RCTs (one RCT was described in two papers) were included. Characteristics of the studies included are shown in Table 1.

INTERVENTIONS

Both studies tested decompression surgery plus oral corticosteroids versus oral corticosteroids alone. One tested treatment of ulnar neuritis of less than 6 months duration[16,17] and one tested treatment of neuritis of several types of less than 6 months duration.[18]

OUTCOME MEASURES

The primary outcomes 'improvement in sensory nerve function 1 year after registration' and 'improvement in motor nerve function 1 year after registration' were evaluated in one trial.[16]

Table 1. Characteristics of included studies. From Van Veen, *et al.* Cochrane Database Sys Review 2009; CD006983; with permission

Study	Methods	Participants	Interventions	Outcomes	Results	Notes
Boucher 1999	Randomised, parallel group trial Randomisation by a computer random number table Blinding not possible	31 leprosy patients with nerve deficit <6 months duration Unit of randomisation: ulnar, median, common peroneal, or posterior tibial nerve Unit of analysis: nerve Nerves randomised: unclear Nerves analysed: 93 (a: 47, b: 46)	(a) prednisone start at 40 mg/day for 15 days and thereafter gradually tapered with 5 mg/15 or 30 days until 6 months completed (total 3450 mg) (b) same intervention plus external nerve decompression and a simple, longitudinal epineurotomy	Sensory improvement (SI) after 2 years, motor improvement (MI) after 2 years, nerve pain after 2 years	No data	Single centre Conducted in Senegal
Ebenezer 1996/Pannikar 1984	Randomised, parallel group trial Randomisation by alternation Blinding not possible	57 leprosy patients with ulnar neuritis <6 months duration Unit of randomisation: person Unit of analysis: ulnar nerve Persons randomised: 57 with 75 ulnar nerves (18 bilateral cases) Nerves analysed: 62 of 44 persons (a: 31, b: 31) after one year, 57 of 39 persons (a: 28, b: 29) after two years	(a) prednisolone 30 mg/day for one week, reducing the daily dose by 5 mg every week for 6 weeks (total 735 mg) (b) same intervention plus external nerve decompression and a simple, subperiosteal medial epicondylectomy	Sensory improvement (SI) after 1 and 2 years, motor improvement (MI) after 1 and 2 years	After one year: Change in SI: MD = 0·08 (95% CI −2·45; 2·61) % with SI: RR = 1·30 (95% CI 0·48; 3·54) Change in MI: MD = 0·82 (95% CI −1·34; 2·98) % with MI: RR = 0·74 (95% CI 0·26; 2·17) Change in SI: MD = 0·08 (95% CI −2·45; 2·61) After two years: Change in SI: MD = −0·02 (95% CI −2·82; 2·78) Change in MI: MD = 0·22 (95% CI −2·39; 2·83)	Single centre Conducted in India

The secondary outcome 'improvement in nerve function 2 years after registration' was evaluated in two trials.[17,18] 'Change in nerve pain and in nerve tenderness' was assessed in one trial[16] 1 year after registration and in two trials[17,18] 2 years after registration. None of the trials evaluated 'changes in quality of life.' Adverse events were not well-reported in any of the trials.

METHODOLOGICAL QUALITY

Randomisation was considered adequate in one trial,[18] while the other trial used alternation as randomisation procedure which was considered inadequate.[16,17] Participant and outcome assessor blinding was not possible in any of the trials. One trial[18] had 6% loss to follow-up of participants, but did not report how many nerves were involved. The other trial[16,17] had 17% loss to follow-up of nerves after 1 year and 24% loss to follow-up of nerves after 2 years. None of the trials reported how many participants or nerves were lost to follow up in each arm. Boucher *et al.* described the reasons for losses. Baseline characteristics in both treatment arms were similar in the trials.

MEDIAL EPICONDYLECTOMY PLUS ORAL CORTICOSTEROIDS VERSUS ORAL CORTICOSTEROIDS ALONE FOR PARTICIPANTS WITH ULNAR NEURITIS OF LESS THAN SIX MONTHS DURATION[16,17]

Results were available for 77% (44/57) of the participants. After 1 year the mean difference in sensory score was 2·08 (95% CI 0·28 to 3·88) in the surgery group and 2·00 (95% CI 0·06 to 3·94) in the medical group indicating a mean sensory improvement in both. The improvement was slightly greater in the surgery group but the mean difference 0·08 (95% CI −2·45 to 2·61) between the two groups was not significant. In the surgery group 18 out of 31 nerves (58%) had sensory improvement after 1 year compared with 16 out of 31 nerves (52%) in the medical group. The difference was not significant (relative risk 1·30, 95% CI 0·48 to 3·54).

Results of changes in motor nerve function were provided. After 1 year the mean difference in motor score was 3·08 (95% CI 2·12 to 4·04) in the surgery group and 2·26 (95% CI 0·21 to 4·31) in the medical group indicating a mean improvement in both. The improvement was greater in the surgery group but the mean difference 0·82 (95% CI −1·34 to 2·98) between the two groups was not significant. In the surgery group 20 out of 31 nerves (65%) had motor improvement after 1 year compared with 22 out of 31 nerves (71%) in the medical group. The difference was not significant (relative risk 0·74, 95% CI 0·26 to 2·17).

Results after 2 years were available for 68% (39/57) of the participants. After 2 years the mean difference in sensory score was 2·89 (95% CI 0·94 to 4·84) in the surgery group and 2·91 (95% CI 0·73 to 5·09) in the medical group indicating a mean improvement in both. The improvement was slightly greater in the medical group but the mean difference −0·02 (95% CI −2·82 to 2·78) between the two groups was not significant. The mean difference in motor score after 2 years was 2·79 (95% CI 1·03 to 4·55) in the surgery group and 2·57 (95% CI 0·49 to 4·65) in the medical group indicating a mean improvement in both. The improvement was greater in the surgery group but the mean difference 0·22 (95% CI −2·39 to 2·83) between the two groups was not significant. Nerve pain and tenderness had disappeared in both groups after 1 year and no new nerve pain or tenderness between the first and second year was reported. The trial did not report any adverse events or reasons of loss to follow-up. Contacting the authors did not yield additional information.

Longitudinal epineurotomy plus oral corticosteroids versus oral corticosteroids alone for participants with neuritis of less than six months duration[18]

Results were available for 97% (30/31) of the participants. Outcomes were given after 2 years of follow-up and were expressed as median improvement, meaning that 50% of the data had greater improvement than this value and 50% of the data had less improvement than this median. In the surgery group median sensory improvement was 25% compared to 20% median improvement in the medical group. The difference was not significant at a 5% level (Tukey box plot test). Median motor improvement was 30% in the surgery group and 20% in the medical group. The difference was not significant at a 5% level (Tukey box plot test). No numbers, test values or 95% confidence interval values were given. In the surgery group median nerve pain relief was 11% compared to 0% in the medical group. The difference was significant at a 5% level (Tukey box plot test). One participant was excluded from the study due to haemorrhage, but it was unclear if it was caused by the intervention. The study did not provide any numbers, test values or 95% confidence interval values. Contacting the author revealed that original data were not available anymore.

Discussion

Two randomised controlled trials were available for this review. One trial compared the added benefit of medial epicondylectomy over corticosteroids for participants with ulnar neuritis of less than 6 months duration.[16,17] The other trial compared the added benefit of longitudinal epineurotomy over corticosteroids for participants with ulnar, median, common peroneal or posterior tibial nerve involvement of less than 6 months duration.[18] The interventions and outcomes were too heterogeneous to be combined in a meta-analysis. The numbers of participants included in the trials were small and did not allow for subgroup analysis. The variability between studies and the limitations in study design and sample size made it difficult to draw any robust conclusions.

None of the trials found a significant difference in improved nerve function between surgery and medical group after a follow-up of 1 or 2 years. This result may have been biased by the selection criteria used for inclusion of patients and nerves. Only a small proportion may benefit from decompressive surgery. Results from a study indicate that only 5–10% of nerves may improve after surgery (Naafs, personal communication). The other nerves need no decompression. By taking all nerves together, results may be diluted and the conclusion clouded.

The two trials had some drawbacks. One major drawback of both trials was that they used sometimes more than one nerve from individual patients in the analyses thereby considering the outcomes from each nerve independent. The trial of Pannikar and Ebenezer included 18 patients with ulnar nerve damage at both sides (bilateral involvement). The right side was allocated to the group drawn by random selection and the left side was allocated to the other group. The final results reflect the outcomes of all nerves. No separate analysis was done using only one independent outcome from each patient. Original data were not available. The trial of Boucher included 31 patients with 93 nerves in total. It is unclear how many nerves each patient contributed. The final results reflect the outcomes of all nerves. No separate analysis was done using only one independent outcome from each patient. Original data were not available. The results from these studies should be treated with considerable caution,

because results from a patient contributing outcomes from more than one nerve will be treated, in the analysis, as having more weight as a patient contributing only one nerve.

Other limitations of the study of Pannikar were that randomisation was done by alternation, which is considered an inadequate randomisation procedure. With regard to loss to follow-up, 23% of the participants were lost to follow-up after 1 year and 32% after 2 years. No reasons for these losses were reported and no intention-to-treat analysis was performed.

The randomisation procedure and loss to follow-up (6%) were considered adequate in the study of Boucher. Outcomes were expressed as median improvement. No numbers or original data were available to calculate mean differences or relative risks making comparison and interpretation of the results difficult. Subgroup analyses showed no difference in median improvement between operated or non-operated nerves with respect to type of leprosy (lepromatous or non-lepromatous), type of antibacillary drug therapy (mono or multi), type of nerve function impairment (motor or sensory), and duration of neuritis (0- to 3 months or 3- to 6 months). There were significant differences for pain relief and severity of the neuritis before surgery. Operated nerves had higher median pain relief compared to non-operated nerves. In the group with considerable loss of nerve function the operated nerves had higher median improvement compared to non-operated nerves.

The occurrence of adverse effects was not adequately reported in the trials. One study[18] excluded a participant with haemorrhage during the course of the trial, but it was unclear whether this was due to the intervention. The literature reviewing decompressive surgery in leprosy often does not take adverse effects into account, but stresses the importance of having adequate techniques and instruments and competent surgeons to prevent unfavourable outcomes.[10,19,20] Complications of decompressive surgery in general may be painful scars, wound problems, haematoma, infection and damage to nerves, arteries or tendons.[21–23]

None of the trials included quality of life measures or cost-effectiveness calculations which could be useful indicators of the effectiveness of interventions.

Many published and unpublished non-randomised studies have examined the effect of decompressive surgery for treating nerve damage in leprosy. While the two RCTs give insufficient evidence in favour of decompressive surgery in addition to steroid treatment, most non-randomised studies report beneficial effects of decompressive surgery. Relief of nerve pain and tenderness is the most frequently and consistently reported benefit. Nerve function improvement is frequently reported, but the response to surgery seems to depend on several factors, such as severity and duration of neuritis before surgery, the type of leprosy, the nerve involved and the surgical technique used. Nerves which are partially damaged, have neuritis of less than 6 months duration and are associated with multibacillary (MB) leprosy show better results.[8,9,11,12,24] Studies examining the effects of surgery reported sensory improvement varying from about 38% to 97% and motor improvement varying from about 26% to 63%.[2,4,7,19,25–33] Comparison of these studies is difficult due to differences in surgical techniques used, duration and severity of neuritis, type of leprosy, follow-up time, and outcome measures.

Several non-randomised studies compared operated versus non-operated nerves. One study evaluated nerve function in nine individuals with neuritis of less than 6 months duration. Three patients underwent ulnar nerve decompression, three patients received corticosteroid therapy for ulnar neuritis and three patients underwent median nerve decompression. The study found an average nerve function improvement of 35% for ulnar

nerve decompression ($n = 3$), 32% for steroid treatment of 8 weeks ($n = 3$) and 18% median nerve decompression ($n = 3$) 6 months after surgery or start of treatment.[34]

Three studies examined surgery alone versus surgery plus steroids. One study compared medial epicondylectomy alone ($n = 7$) with medial epicondylectomy plus steroids ($n = 7$) given 2 weeks post-operatively for ulnar neuritis of less than 1 month duration. After a 5 month follow-up motor improvement was not better in the group receiving additional steroids.[35] Another study compared neurolysis ($n = 21$) with neurolysis in combination with perineural corticosteroid injections ($n = 18$) for ulnar neuritis of less than 6 months duration. The injections were administered around the thickened nerve after surgery and 2 and 3 weeks later. One year after surgery the mean difference between final and initial nerve function score was 14 for the surgery only group and 21 for the surgery plus steroids group.[6] The third study compared decompressive surgery alone ($n = 59$) with surgery plus steroids ($n = 25$) given for 3 to 4 months for sensory impairment of the posterior tibial nerve of varying duration. Satisfactory recovery of nerves with duration of anaesthesia of less than 6 months was 60% in the surgery group and 83% in the surgery plus steroids group 4 weeks after surgery.[5]

One study compared operated nerves with contralateral non-operated nerves. Prior to surgery all participants had received 3 months of steroid treatment. The most affected nerves underwent surgical decompression and were compared with the contralateral non-operated nerves 1 year or more after surgery. Of the more than 100 nerve decompressions four operated nerves had decreased nerve function after 1 year of follow-up. The other operated nerves had unchanged or improved nerve function 1 year after surgery. It is unclear how many of the contralateral non-operated nerves improved or deteriorated.[36]

After losses to follow-up, another study compared operated nerves ($n = 195$) of 95 patients with non-operated nerves of 96 patients, matched for type of leprosy, age and duration of sensory loss but not randomised, on changes in sensation. Participants, in whom no improvement of sensory nerve function was found after a standard steroid treatment (40 mg prednisolone daily for 3 weeks after which the dosage was reduced by 5 mg per week), were included in the study. Between 27% and 66% of the nerves had definite improvement 2 years after surgery compared to 7% of the non-operated nerves which improved.[37] Improvement was more likely if the sensory loss had been present for a shorter time. Studies from Carayon *et al.* favour surgery plus medical treatment above medical treatment alone.[1,38,39]

Corticosteroids are the cornerstone of management in acute nerve damage in leprosy, are recommended by the WHO and are widely available. But corticosteroids have some shortcomings. The effects of corticosteroids in the long-term remain uncertain and a considerable proportion of people treated for nerve damage do not benefit from corticosteroid treatment. Long-term therapy may cause serious adverse effects, such as peptic ulcer, cataract, or psychosis. Spontaneous improvement or recovery of nerve function in untreated or placebo treated individuals has been reported and needs more investigation. The limitations of corticosteroids urge the need to find alternative therapeutic approaches.[40] Surgery alone as therapy for treating neuritis is not recommended, but there is discussion about whether the combination of surgery and medical treatment (e.g. steroids) will give better results than medical treatment alone and there is a call for appropriate trials examining this question.[9,10,20]

Conclusion

IMPLICATIONS FOR PRACTICE

Evidence from the two randomised controlled trials is insufficient to draw robust conclusions about the effect of decompressive surgery for treating nerve damage in leprosy. Two trials examining the added benefit of surgery over steroids for neuritis of less than 6 months duration did not show significantly better outcomes with steroids plus surgery than steroids alone in the long-term. Adverse effects of decompressive surgery for treating nerve damage in leprosy are not well-documented.

IMPLICATIONS FOR RESEARCH

There is a need to identify factors which will predict a favourable response to decompressive surgery or groups of patients or nerves that will be likely to benefit from surgery. Future randomised controlled trials should be well-designed to establish the usefulness and effectiveness of the combination of decompressive surgery and medical treatment compared to medical treatment alone. New trials should pay more attention to non-clinical aspects, such as costs and impact on quality of life, because these are highly relevant indicators for both policy makers and participants.

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