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Original Research

Long-Term Outcomes of Donor Site Morbidity After Sural Nerve Graft Harvesting

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Purpose: Although nerve autografts have been considered the standard treatment for peripheral nerve defects, limited studies have reported long-term outcomes of nerve harvesting over 15 years after surgery. This study aimed to evaluate the long-term outcomes of donor site morbidity after sural nerve graft harvesting.

Methods: Thirteen patients for whom more than 15 years had passed after harvesting of the sural nerve for peripheral nerve defects were included. Mean follow-up was 29.5 years. Sensory disturbances and difficulty in performing foot movements immediately after surgery and currently were evaluated on a 10-point scale. Influences on daily living and work and current satisfaction with the autologous sural nerve graft were evaluated.

Results: Sensory disturbances and difficulty in movement tended to improve; however, the differences between time points were not significant. Influences on activities of daily living and work were mild, and the satisfaction level for autologous sural nerve graft was high.

Conclusions: Although donor site morbidity after sural nerve graft harvesting persisted for a long time after surgery, foot symptoms and functional impairment were mild.

Type of study/level of evidence: Therapeutic V.

Since the publication of data by Millesi et al,[1] nerve autograft has been considered the standard treatment for peripheral nerve defects. However, because this procedure involves harvesting healthy nerves as the graft, accompanying sensory disturbances and residual pain can occur.[2–4] To avoid this donor site morbidity, artificial nerve graft and processed allograft have been studied as alternatives to nerve autograft. Particularly in recent years, processed allografts have been rapidly applied in clinical practice, mainly in the United States and Europe. However, there is limited information about the long-term outcomes of donor site morbidity with the use of nerve autografts, such as sensory disturbance, residual pain, and influence on daily living.[5–7] To evaluate the long-term outcomes of donor site morbidity, we investigated problems with lower limbs in patients who underwent nerve autograft with sural nerve harvesting over 15 years previously.

Materials and Methods

Patients and ethics

Among 79 patients who underwent nerve autograft with sural nerve harvesting for peripheral nerve defect in our hospital or affiliated hospitals from 1981 to 2002, 13 patients who agreed to participate in the study and completed the questionnaire were included in this study. The questionnaires were sent by mail. For 46 of 79 patients, patients had a different address and could not be located. Of the remaining 33 patients, 20 did not return the questionnaire. The response rate of the questionnaire was thus 39.4%. Of 13 patients, 9 were men, and 4 women. We harvested the sural

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nerve from the distal part of the lower leg using one incision in all patients.

Evaluation

Evaluations were conducted using a questionnaire with a 10-point scale. Evaluation items included sensory disturbance of the feet (0 = no disturbance, 10 = extreme disturbance) and difficulty in movement of the feet (0 = no difficulty, 10 = extreme difficulty) immediately after surgery and currently. In addition, current influence on activities of daily living (ADL) and work (0 = no trouble, 10 = troubling), consistency with expectations for recovery (0 = disappointing, 10 = as good as expected), and satisfaction with the autologous sural nerve graft (0 = unsatisfied, 10 = completely satisfied) were evaluated. We evaluated the correlation between satisfaction and other surveyed items. Furthermore, we asked subjects about the presence of symptoms associated with painful neuroma, such as a Tinel sign. We also asked whether the subject wished to receive a nerve autograft if another nerve defect occurred (options were: (1) I wish to receive a nerve autograft, (2) I do not wish to receive a nerve autograft, and (3) I do not know).

Statistical analyses

We compared items between 2 time points (ie, immediately after the surgery and currently) using the paired *t* test; the correlation was examined using the Pearson correlation coefficient with a statistical significance of 5%.

This research was approved by the institutional review board of the authors' affiliated institution. All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation and with the 1975 Declaration of Helsinki, and informed consent was obtained from each subject.

Results

Mean age at the surgery was 38.2 years (range, 15–63 years) and mean number of years after surgery was 29.5 years (range, 16–37 years). Causes of nerve defect were trauma and tumor in 10 and 3 patients, respectively. Reconstructed nerves were mixed nerves in 8 patients (median nerve in 2, femoral nerve in 1, tibial nerve in 1, peroneal nerve in 1, ulnar nerve in 1, and other nerves in 2) and sensory nerves in 5 (digital nerve in 4 and superficial radial nerve in 1). Mean length of the nerve defect was 67.8 mm (range, 10–250 mm) and mean length of the harvested nerves was 108.3 mm (range, 20–320 mm).

Foot symptoms after surgery and currently

Table 1 shows residual symptoms in terms of sensory disturbance at the feet and regarding difficulty in movement before and after surgery. Symptoms tended to improve, but differences between the time points were not statistically significant. No patients showed symptoms associated with painful neuroma.

Activities of daily living and patient satisfaction

Patients reported little impairment in ADL and work, with mean (SD) visual analog scale scores of 1.2 (2.2) and 1.4 (2.5), respectively. Consistency with expectations for recovery was 7.1 (2.7), and satisfaction with the autologous sural nerve graft was 7.9 (3.3). Regarding patient satisfaction, Table 2 shows Pearson correlation coefficients for patient satisfaction with the nerve autograft. Satisfaction was strongly correlated with consistency with expectations for recovery ($r = 0.89$; $P < .001$). Time since the surgery ($r = 0.63$; $P = .02$), current difficulty in movement ($r = -0.66$; $P = .01$), and effect on ADL ($r = -0.68$; $P = .01$) and on work ($r = -0.68$; $P = .01$) were also correlated with long-term patient satisfaction.

Table 1
Symptoms of Feet at 2 Different Time Points

Variable	Immediately After Surgery (mean [SD])	Currently (mean [SD])	*P* Value
Sensory disturbance	3.0 (3.7)	2.2 (3.2)	.12
Difficulty in movement	2.3 (3.4)	1.3 (2.7)	.13

Nine subjects wanted to receive a nerve autograft if faced with a new injury, whereas one did not answer the question. One subject did not want to receive a nerve autograft because he did not expect recovery owing to more advanced age. Two subjects were unsure regarding the nerve autograft because the recovery of one was not as expected, and the other preferred to decide after consulting with her doctor. The level of satisfaction was 9.2 (1.7) in patients who wanted to receive a nerve autograft and 3.9 (3.9) in patients who were unsure or did not want to receive a nerve autograft. This showed that individuals with high satisfaction generally wanted to receive a nerve autograft again.

Discussion

Our study showed that although patients reported some donor site morbidity after sural nerve graft harvesting persisted for a long time, foot symptoms and functional impairment were mild. Moreover, satisfaction with the autologous sural nerve graft was strongly correlated with the consistency of the expected recovery. These results suggest that autologous sural nerve graft continues to be a useful method for patients in whom good recovery after nerve grafting is expected.

Our results are consistent with the prior literature (Table 3). Ehretsman et al[8] conducted a telephone survey of 16 patients who underwent sural nerve graft. The authors compared current conditions with those immediately after surgery and found that sensory loss and residual pain in the area of nerve harvesting greatly improved. Recovery of the nerve defect was also correlated with the recovery of the donor site. Miloro and Stoner[9] conducted a telephone survey of 26 patients who underwent sural nerve grafting over an average of 3 years and reported results similar to the study conducted by Ehretsman et al[8] IJpma et al[6] conducted a questionnaire survey of 29 patients who underwent sural nerve grafting after 26 years, and compared current conditions with those immediately after surgery. They found that the size and severity of the sensory loss area showed notable improvement over time, and satisfaction with the nerve autograft was high. Hallgren et al[7] also

Table 2
Correlations Between Different Study Parameters and Patient Satisfaction With Nerve Autograft

Variable	Pearson Correlation Coefficient	*P* Value
Age at surgery	−0.16	.60
Time since surgery	0.63	.02
Length of nerve defect	−0.3	.31
Length of harvested nerve	0.14	.64
Current sensory disturbance	−0.52	.07
Current difficulty in movement	−0.66	.01
Influence on daily living	−0.68	.01
Influence on work	−0.68	.01
Consistency with expectations for recovery	0.89	< .001

Table 3
Similar Studies and Their Major Results Regarding Lower-Limb Problems After Sural Nerve Graft Harvesting

Method	Patients, n	Mean Age at Surgery, y	Follow-Up, y	Results	Study
Telephone survey	16	Unknown	About 5	Area of sensory loss was greatly improved	Ehretsman et al, 1999[8]
Telephone survey	26	32	3	Severity of sensory loss was considerably improved	Miloro and Stoner, 2005[9]
Interview	28	25	1	Area of sensory deficit was much improved	Martins et al, 2012[10]
Interview	46	18.1	4	Pain and functional deficit were mild	Butler et al, 2017[11]
Questionnaire survey	29	30	26	Area and severity of sensory loss and pain were notably improved	IJpma et al, 2006[6]
Questionnaire survey	41	23	12	Sensory deficit was decreased in 19 of 41 patients	Hallgren et al, 2013[7]
Questionnaire survey	13	38.2	29.5	Severity of sensory disturbance tended to improve	Current study

conducted a questionnaire survey among 41 patients who underwent sural nerve grafting after an average of 12 years. They found that the impact of donor site morbidity on ADL was limited. These reports are different from our study in that those authors found a major improvement in subjective symptoms between time points immediately after surgery and at latest follow-up.

Other studies have examined morbidity with a shorter follow-up period. Martin et al[10] conducted 1-year follow-up in 38 patients who underwent sural nerve grafting and found that the area of sensory loss decreased with time and was correlated with the length of the harvested nerve. Furthermore, Butler et al[11] harvested sural nerves with endoscopy and performed nerve autografts. They investigated 46 patients who underwent surgery after an average of 4.3 years and found that pain in the area of nerve harvesting and the functional deficit of the lower limb were mild. Those studies all concluded that autologous sural nerve graft was a useful method because the patients' problems caused by nerve harvesting improved over time, and there was limited impact on ADL.

Although our study results were similar to those previously reported, we detected no significant differences between the time points examined. The lack of significance may have resulted from the small sample size included in our study. Although the questionnaire response rate was 39.4%, a more robust response such as that reported by Hallgren et al[7] (89.1%) may yield statistically significant differences.

In our study, rather than lower-limb problems at the time of intervention, consistency with expected recovery had the strongest correlation with patient satisfaction (Table 1). Although there is a large individual difference in recovery after autologous sural nerve graft, our results suggested that satisfaction may be improved by providing as much information as possible about prognosis, because it can be influenced by the type, location, and size of the nerve defect.

Many studies[1-3] regarding regeneration of peripheral nerves suggested that "complaints after healthy nerve harvesting are serious problems in autologous nerve grafting"; hence, artificial nerve grafts and processed allografts that do not require nerve harvesting have been studied. However, in this study, lower-limb problems after sural nerve harvesting were milder than expected, which suggests that autologous nerve grafting might be a better method than was previously considered in patients in whom expected recovery was good.

This study had some limitations. Owing to its small sample size and low response rate, there was a potential for selection bias. In addition, there was a potential for recall bias owing to the long interval between surgery and data collection. Indeed, after a long time, patients may have underestimated the amount of disability immediately after surgery. They limited the number of conclusions that could be drawn based on our results. Furthermore, the severity of the sensory disturbance was a subjective measure because we conducted the questionnaire survey without a physical examination, Semmes-Weinstein monofilament test, or 2-point discrimination test. Another limitation of this study was that the functional evaluation was not performed using validated functional scales.

Although donor site morbidity after sural nerve graft harvesting persisted for a long time after surgery, residual symptoms at the foot and functional impairment were mild. Satisfaction with the autologous sural nerve graft was strongly correlated with the consistency with expectations for recovery. These results suggest that autologous sural nerve graft could be a useful method for patients in whom a good recovery is expected.

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