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ORIGINAL ARTICLE

Hand/Peripheral Nerve

Meta-Analysis of Long Thoracic Nerve Decompression and Neurolysis Versus Muscle and Tendon Transfer Operative Treatments of Winging Scapula

Rahul K. Nath, MD
Chandra Somasundaram, PhD

Background: Injury to long thoracic and the spinal accessory nerves can cause winging scapula as a result of weakness and paralysis of the trapezius and serratus anterior muscles. Although these nerve and muscle operations have been reported to correct winging scapula due to various causes, there is no report on comparing the outcomes of these procedures in peer-reviewed Pubmed-indexed literature. In this article, we compared the improvements in the restoration of shoulder functions in winging scapula patients after long thoracic nerve decompression (LTND) in our present study with outcomes of muscle and tendon transfer operations published in the literature (Aetna cited articles).

Methods: Twenty-five winging scapula patients met the inclusion criteria, who had LTND and neurolysis at our clinic since 2008. Electromyographic evaluation of the brachial plexus and long thoracic nerve distribution was performed preoperatively for all our patients in this study. Operating surgeon (R.K.N.) examined all patients and measured pre- and postoperative range of motion of the affected shoulder. The mean follow-up was 23 months (range, 13–46 months). Age of our patients in this study at the time of surgery was between 13 and 63 years. These patients had winging scapula between 5 days (tennis injury) and several years before surgery and some were unknown.

Results: Shoulder flexion and abduction improved to an average of 163° ($P < 0.000006$) and 157° ($P < 0.0000005$) from 104° and 97° at least 1-year post-LTND in 25 winging scapula patients in our present study. This is statistically significant in comparison to the reported improvements resulting from muscle and tendon transfer procedures in the Pubmed-indexed (Aetna cited) literature.

Conclusion: This meta-analysis suggests that nerve surgeries such as LTND and neurolysis are effective techniques in correcting winging scapula in comparison with muscle transfer operations. *(Plast Reconstr Surg Glob Open 2017;5:e1481; doi: 10.1097/GOX.0000000000001481; Published online 10 August 2017.)*

BACKGROUND

Injuries to long thoracic and the spinal accessory nerves are the most frequent cause of winging scapula[1,2] as a result of weakness and paralysis of the trapezius and serratus anterior muscles.[3] Dynamic winging scapula[4] resulting from long thoracic and the spinal accessory nerve palsy is restored in general by nerve decompression and neurolysis.[5–9] Static winging scapula[4] in muscular dystrophy, facioscapulohumeral dystrophy, is corrected mainly by scapulothoracic fusion/arthrodesis and tendon transfer procedures.[2,10–17]

In this article, we report statistically significant improvements in shoulder flexion and abduction in 25 winging scapula patients by long thoracic nerve decompression (LTND) and neurolysis. Further, reporting meta-analysis of our present data, and our published results in this subject versus the reported outcomes of muscle or tendon transfer procedures in the restoration of shoulder functions in winging scapula patients in the Pubmed (Aetna cited) literature.

From the Research, Texas Nerve and Paralysis Institute, Houston, Tex.
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Table 1. Demographic of LTND Patients in this Study

Patient Number	Age at Surgery	Period of Winging Scapula (y)	Cause
1	13	1	Unknown
2	26	2	Nerve exploration
3	61	3	Fell on ice with weight
4	25	8	Unknown
5	44	0.1	Unknown
6	40	2.5	Fall of off airplane
7	27	8	Unknown
8	25	Unknown	All-terrain vehicle accident
9	28	0.5	Carrying heavy equipments
10	20	3	Playing baseball
11	47	4	Work injury
12	54	2	Fell
13	15	1.8	Cheerleading basket toss
14	48	2.5	Chiropractic adjustment
15	37	0.5	Motor vehicle accident
16	43	0.3	Unknown
17	61	0.2	Unknown
18	24	Unknown	Backpacking/weight lifting
19	63	0.3	Pull-ups
20	25	Unknown	Carrying 40 lbs in grocery bag
21	15	Unknown	Softball pitching
22	28	5	Thoracic outlet surgery
23	22	5 d	Tennis injury
24	42	0.7	Lifting weights
25	23	1.3	Lifting weights

METHODS AND PATIENTS

We retrospectively analyzed our patients' records, who had LTN decompression and neurolysis[6,7] since 2008. This excludes our winging scapula patients in our previous publications.[6,7] Twenty-five winging scapula patients met the inclusion criteria in our present study, who had LTN decompression and neurolysis at our clinic since 2008 and had postoperative follow-up over 1 year. Electromyographic evaluation of the brachial plexus and long thoracic nerve distribution was performed[8,18] preoperatively for all our patients in this study. Operating surgeon (R.K.N.) examined all patients and measured pre- and postoperative range of motion of the affected shoulder. We adhered to the following inclusion and exclusion criteria of our patients from LTND surgery in our present study.

Inclusion Criteria

Articles from Aetna document that are indexed in Pubmed, reporting Active Range of Motion (AROM), shoulder flexion and abduction, in winging scapula patients, who had muscle and tendon transfer procedures.

Exclusion Criteria

1. Surgical outcomes of our patients' data that was published already.
2. Case reports and review articles.

RESULTS

Scapular winging was present on physical examination in all patients. The mean follow-up was 23 months (range, 13–46 months). Age of our patients in this study at the time of surgery was between 13 and 63 years. These patients had winging scapula between 5 days (tennis injury) and several years before surgery and some were unknown. The cause of winging scapula, age at the time of surgery, the time between injury and surgery in our study patients are given in Table 1.

Electrophysiological studies (motor and sensory nerve conduction) showed a delayed distal latency and revealed evidence of active denervation in the serratus anterior muscle/long thoracic nerve in the affected side of our patients in this study, who had undergone LTND and neurolysis.

Shoulder flexion and abduction improved to an average of 163° ($P < 0.000006$) and 157° ($P < 0.0000005$) from 104° and 97° at least 1 year post-LTND in 25 winging scapula patients in our present study (Table 2; Fig. 1).

Table 2. Improvement of AROM in 25 Winging Scapula Patients after LTND in the Present Study

Patient Number	Preflexion (degree)	Preabduction (degree)	Postflexion (degree)	Postabduction (degree)	Follow-Up (mo)
1	90	90	180	180	25
2	30	30	180	180	15
3	90	90	180	180	13
4	30	30	90	90	17
5	120	120	180	180	31
6	120	120	180	180	14
7	180	120	180	180	12
8	90	90	180	180	14
9	90	30	90	30	26
10	90	90	90	90	15
11	30	30	180	180	26
12	90	90	120	120	22
13	120	90	120	120	31
14	90	90	180	180	36
15	120	120	180	180	24
16	120	120	180	180	12
17	120	120	180	180	14
18	180	120	180	180	19
19	120	180	180	180	25
20	120	120	180	180	14
21	120	90	180	180	14
22	120	120	180	90	46
23	120	120	180	180	38
24	120	180	180	180	36
25	30	30	180	180	33
Mean	104	97	163	157	23
Standard deviation	38	37	33	43	
P			0.000006	0.0000005	

Fig. 1. Apparent improvement in shoulder abduction and flexion from 0˚ AROM to 170˚ after LTND and neurolysis in the winging scapula patient at our clinic in this report. A 13-year-old boy with right winging scapula resulting from exercise and over use of the arm. A and B, Pre- and postoperative (LTDN) pictures. Apparent improvement from 0˚ AROM to 170˚.

This is statistically significant in comparison with the reported improvements resulting from muscle and tendon transfer procedures in the Pubmed-indexed (Aetna cited) literature (Fig. 2).

Further, we compared this improvement after LTND with outcomes of muscle transfer surgical procedures published in the Pubmed-indexed literature (Aetna cited articles) and summarized in Table 3.

DISCUSSION

Some of our patients had unsuccessful nonoperative treatments, such as physical therapies and bracing. Other investigators have reported that at least a quarter of winging scapula patients did not respond to nonsurgical therapies.[19] Studies involved muscle procedures that have not reported the improvement of shoulder abduction and flexion angle from Table 3 (Pahys et al.,[13] Galano et al.,[2] Wiater and Flatow[16]) are also excluded in the meta-analysis report in Figure 2.

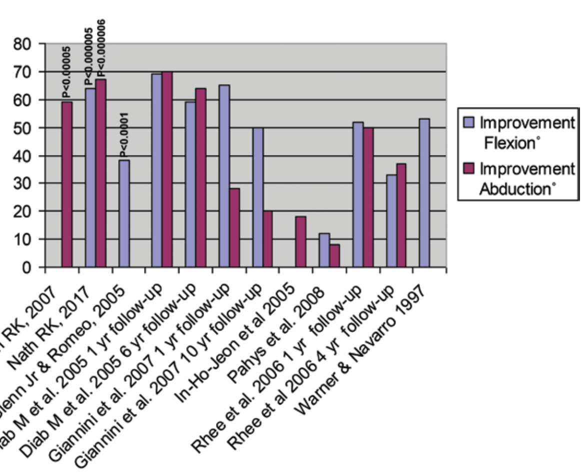

Fig. 2. Outcomes of LTND versus muscle and tendon transfer operations in winging scapula patients.

Investigators, who performed muscle and tendon transfer procedures, reported their patients' outcomes and improvements in shoulder abduction and flexion are shown in figure 2 (Aetna list) to compare to our patients' outcomes after LTND. However, they have not reported whether their data were statistically significant or not, except for Glenn Jr, and Romeo, 2005.[20] Teboul et al.[21] suggested neurolysis, nerve graft, or repair within 6–12 months in injuries resulting from surgery or penetrating trauma. Some of our winging scapula patients in this report had onset over 12 months, and yet they had significant improvement after LTN decompression and neurolysis.

CONCLUSION

This meta-analysis report suggests that nerve surgeries such as long thoracic or spinal accessory nerve decompression and neurolysis are effective techniques in correcting winging scapula in comparison with muscle and tendon transfer operations.

PATIENT CONSENT

The patient provided written consent for the use of his image.

Rahul K. Nath, MD
Texas Nerve and Paralysis Institute6400, Fannin st
Houston
TX 77030
E-mail: drnath@drnathmedical.com

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Table 3. This Table Summarizes the Improvements of LTND Versus Other Muscle Procedures Published in the Pubmed-Indexed Literature (Aetna Cited Articles) in Winging Scapula Patients

Surgery	Authors	Improvements
Nerve procedures		
LTND neurolysis	Nath RK, Melcher SE, 2007[6]	Active abduction improved from 105° to 164° ($P < 0.00005$)
LTND neurolysis	Nath RK, Somasundaram C (present study)	Outcome of 25 WS patients in the present study, 64°, and 67° improvement in flexion and abduction, respectively ($P < 0.000006$)
Muscle procedures		
Scapulothoracic fusion	Diab et al., 2005[10]	Active abduction 75–145°; shoulder flexion 75–144°; 1.0-y follow-up Active abduction 75–139°; shoulder flexion 75–134°; 6.3-y follow-up
Scapulopexy	Giannini S et al., 2007[15]	Active abduction 70–98°; shoulder flexion 55–120°; 1.0-y follow-up Active abduction 70–90°; shoulder flexion 55–105°; 10-y follow-up
Scapulothoracic fusion	Jeon IH et al., 2005[12]	Active abduction 80–98° 49-month follow-up
Scapulothoracic arthrodesis	Rhee YG, Ha JH, 2006[14]	Active abduction 71–121°; shoulder flexion 76–128°; 1.0-y follow-up Active abduction 71–108°; shoulder flexion 76–109°; 4.0-y follow-up
Scapulothoracic arthrodesis	Glenn RE, Jr, Romeo AA, 2005[20]	Shoulder flexion 74–112° ($P = 0.0001$)
Tendon transfer	Warner JJ, Navarro RA, 1998[17]	Flexion improved 97–150°
Scapulothoracic fusion	Pahys JM et al., 2009[13]	No pain in 75% (3 patients) and 3/10 pain in 1 patient after the surgery. No change in AROM in 3 patients AROM 50/85 to 100/110 in 1 patient
Eden-Lange procedure	Galano GJ et al., 2008[2]	ASES score 141.7–151 Visual analog score 7–2.3
Tendon transfer	Wiator JM, Flatow EL, 1999[16]	Postoperative elevation was 175" (range, 150–180"). Average preoperative pain score (0 = no pain; 10 = maximum pain) of 8.2 decreased to 3.

ASES, The American Shoulder and Elbow Surgeons Shoulder score; LTN, long thoracic nerve; WS, winging scapula.

Institutional Review Board Statement: This was a retrospective study of patient charts, which exempted it from the need for IRB approval in the United States. Patients were treated ethically in compliance with the Helsinki declaration. Documented informed consent was obtained for all patients.

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