Original Article

The Therapeutic Outcomes of Trapezius Muscle Transfer in Brachial Plexus Injury Patients: A Case Analysis at 15 Khordad Hospital, Tehran

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ABSTRACT

Background: We investigated the therapeutic outcomes of trapezius muscle transfer in individuals diagnosed with brachial plexus damage.

Methods: We examined patients diagnosed with brachial plexus palsy referred to 15 Khordad Hospital in Tehran, Iran during 2018-20. The patients considered for inclusion in the study were those who were eligible for trapezius muscle transfer surgery, either on the affected side or the unaffected side. The evaluation focused on various aspects, including shoulder range of motion, muscle strength, shoulder pain, age and gender distribution, as well as satisfaction and function levels of the shoulder.

Results: The suitability of shoulder motions, shoulder abduction, and muscular strength in patients who underwent ipsilateral side trapezius muscle transfer surgery was greater compared to those who underwent contralateral side trapezius transfer. In the investigation of postoperative shoulder function among patients who underwent trapezius muscle transfer surgery on the ipsilateral side, it was shown that 3 patients (25%) exhibited favorable function, while 6 patients (50%) demonstrated acceptable function, and 3 patients (25%) displayed excellent function. Out of the total sample size of 9 patients who underwent surgery for trapezius muscle transfer on the contralateral side, 6 patients (66.7%) exhibited favorable function, while 3 patients (33.3%) demonstrated acceptable function.

Conclusion: Employing the contralateral trapezius muscle as a substitute when utilizing the ipsilateral trapezius muscle is not feasible is a viable alternative with favorable function.

KEYWORDS
Brachial plexus injury; Trapezius muscle transfer; Therapeutic Outcomes

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INTRODUCTION

Individuals diagnosed with brachial plexus paralysis experience restricted shoulder mobility and face limited alternatives for restoring movement[1].These choices encompass arthrodesis, surgery, and a combination of muscle displacement techniques[2]. Following paralysis of the deltoid and supraspinatus muscles, there is a displacement of the trapezius, pectoralis major, teres minor, and latissimus dorsi muscles[3].

Typically, the re-establishment of elbow movements is commonly pursued using interventions such as nerve grafting, nerve transferring, and free muscle transferring. While the advantages of these motions are confined to the mobility of the shoulder, it is seen that the patient exhibits an inability to elevate their hand from the abdominal region[4,5]. The stability of the shoulder joint is a crucial factor in facilitating the movements of the arm and forearm. The transfer of the trapezius muscle is employed to counteract these movements, specifically abduction and external rotation of the shoulder[6].

Additionally, shoulder abduction is a crucial factor in determining the arm and forearm's range of motion. In cases when the brachial plexus has been damaged, the ability to perform shoulder movements may be compromised or eliminated. In the initial post-injury period, it is feasible to achieve recovery by the implementation of surgical interventions involving the transplantation of nerve branches. Following a year post-injury, the available alternatives for restoring shoulder mobility are constrained, encompassing trapezius muscle transfer, arthrodesis, surgery, or a combination thereof. Tendon transfer is the primary treatment option for those suffering from shoulder paralysis since it has been shown to significantly enhance functional outcomes[7].The transfer of the upper trapezius muscle tendon is a widely utilized procedure for managing shoulder movements in individuals with brachial plexus paralysis[8-15]. In contemporary practice, the transfer of the trapezius tendon, either from the same side or the opposite side, is commonly performed in conjunction with the lumbosacral fascia to enhance stability and facilitate shoulder movements. This procedure involves the transfer of these structures to the infraspinatus tendon[5].

We aimed to examine the outcomes of trapezius muscle transfer surgery in enhancing shoulder mobility among individuals with brachial plexus paralysis.

MATERIALS AND METHODS

The statistical population of this study consisted of patients diagnosed with brachial plexus palsy referred to 15 Khordad Hospital in Tehran during 2018 and 2020. The referral of patients with brachial plexus injuries to this center is attributed to the necessity of a proficient and experienced team of hand surgeons and plastic surgeons specialized in this domain. Consequently, the surgical procedure in question is categorized as an infrequent and uncommon operation. Given the limited size of the statistical population, all patients eligible for tendon displacement surgery were included in the study as the available sample, resembling a census.

The inclusion criteria for this study were as follows: 1) A minimum of one year has elapsed from the occurrence of the brachial plexus injury. 2) The trapezius muscle on both the affected side and the opposite side must exhibit normal functionality. 3) The lack of concomitant injuries and other movement abnormalities 4) Appropriate criteria for the trapezius muscle tendon transfer procedure and the feasibility of utilizing general anesthesia during the surgical intervention. 5) The potential for patient monitoring and regular access to conduct periodic examinations. 6) The patient's voluntary agreement, based on informed consent, to undergo the surgical procedure.

The study did not include patients who did not meet any of the inclusion criteria. During the initial consultation, a comprehensive assessment of the patient was conducted, encompassing a thorough examination and detailed medical history. This examination involved evaluating the range of motion and muscle strength in the shoulder, as well as determining the presence or absence of pain during shoulder movements and overall shoulder function. Additionally, the patient's general health level and any associated medical conditions were taken into consideration. Furthermore, a careful examination was conducted to identify any associated injuries, and the patient's previous surgical records were reviewed. The trapezius muscle on both the injured side and the opposite side was also examined. Finally, the time interval between the patient's visit and the occurrence of the injury was documented and recorded in the patient's file. The identification of appropriate candidates for trapezius muscle transfer surgery, to enhance shoulder movements, was undertaken. The patients were provided with explanations regarding the methods and protocols of the surgery, as well as the potential complications that may arise. Informed consent was subsequently gained from the patients. The patients underwent surgery under the required planning and scheduling.

Techniques of Surgery

Trapezius muscle transfer on the ipsilateral side

The modified surgical technique developed by Batman was used for performing trapezius muscle transfer on the ipsilateral side. The patient was positioned in the beech chair posture, and following thorough preparation of the upper limb, a curved incision was performed on the deltoid muscle. Upon elevating the cutaneous and subcutaneous layers, the trapezius muscle was dissected from the acromioclavicular joint, concomitantly with a portion of the acromion bone and clavicle. Following the relaxation of the muscle and attainment of the desired length, the upper extremity was positioned in shoulder abduction. Subsequently, the relaxed muscle was affixed to the initial region of the humerus bone using two or three screws. The organ was immobilized in a fixed posture using plaster, which was maintained for six weeks. Subsequently, the angle of shoulder abduction was decreased successively from 90 degrees to 60 degrees and further to 30 degrees. Ultimately, after approximately 10-12 weeks, the commencement of bodily motions was observed.

Trapezius muscle transfer on the contralateral side

The procedure was conducted with the patient in a prone position, lying on his stomach. The surgical preparation encompassed the entirety of the posterior trunk and upper limbs. Following the initial skin incision, the skin flap and subcutaneous tissue of the trapezius muscle on the contralateral side of the injury are dissected, elevated, and subsequently detached from the surrounding musculature, particularly the latissimus dorsi. The muscle ascends towards the superior third and aligns with the inferior angle of the scapula. Once the muscle had attained the appropriate length, it was subsequently relocated to the afflicted shoulder region via subcutaneous tunnels. In this region, it was anatomically linked to the acromion bone at a right angle. The limb was immobilized in a position of 90 degrees of abduction. The subsequent phase of the treatment was conducted utilizing the identical methodology employed during the preceding surgical procedure.

The clinic conducted regular patient follow-ups through periodic visits and post-operative treatment and documented the outcomes after one year following surgery using interviews and clinical examinations. The results collected were subjected to analysis using statistical tools. The categorization of pain was based on the patients' most recent clinical visit, wherein it was categorized into four distinct forms: painless, mild, moderate, and severe. The assessment of the shoulder range of motion was conducted through a clinical examination, taking into consideration the degree of bilateral upper limb movement, with particular emphasis on external rotation. The assessment of muscle strength was conducted using the British muscle strength test.

Following the data collection process, descriptive statistical techniques, such as calculating the mean and standard deviation, were employed to conduct a statistical analysis of the variables. To assess the differences between pre-and post-operative conditions, a paired *t*-test was employed for quantitative data, while the McNemar statistical approach was utilized for analyzing frequencies of qualitative variables. The program employed in this study was SPSS17\win (Chicago, IL, USA). A significance level of less than 0.05 was used to determine statistical significance.

RESULTS

A cohort of 21 individuals had surgical intervention using trapezius muscle transfer. Table 1 showed that

Table 1: Frequency of Gender and Trapezius Muscle Side

Variable		Frequency	Percent	Valid Percent	Cumulative Percent
SEX	**male**	16	76.2	76.2	76.2
	female	5	23.8	23.8	100.0
	Total	21	100.0	100.0	
Group					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	**lateral**	12	57.1	57.1	57.1
	contra lateral	9	42.9	42.9	100.0
	Total	21	100.0	100.0	

there were 16 male patients (76.2%) and 5 female patients (23.8%). In the performed study, a total of 12 patients (57.1%) underwent trapezius muscle transfer surgery on the ipsilateral side, whereas 9 patients underwent trapezius muscle transfer surgery on the contralateral side (42.9%).

The study examined the mean age of patients who underwent ipsilateral-side trapezius muscle transfer surgery, found to be 28.4±10.2. Similarly, the mean age of patients who underwent contralateral side trapezius muscle transfer surgery was determined to be 26.3±6.8.

Examining Shoulder Range of Motion

The present study examined the shoulder range of motion and shoulder abduction in a cohort of patients who underwent ipsilateral-side trapezius muscle transfer surgery. Among the participants, 25% (n=3) exhibited a range of motion between 30-60 degrees, while another 25% (n=3) demonstrated a range of motion between 60-90 degrees. The majority of patients, constituting 50% (n=6), exhibited a range of motion exceeding 90 degrees (Table 2).

Based on the results of the chi-score test in the study of patients who underwent surgery to transfer the trapezius muscle on the opposite side, there were 2 patients (22.2%) in the range of motion of 30-60 degrees and 5 patients (55.6%) in the range of motion of 60-90 degrees and the number of 2 patients (22.2%) were in the range of motion more than 90 degrees. In the statistical analysis, no significant difference was observed in the comparison of the two groups.

Examining the Pain Level of Patients

In the group of patients who underwent surgery to transfer the trapezius muscle to the ipsilateral side, 9 patients (75%) had no pain after surgery, 1 patient (8.3%) had mild pain, and 2 patients (16.7%) had moderate pain. Besides, in the group of patients who underwent surgery to transfer the trapezius muscle to the contralateral side, 5 patients (55.6%) had no pain, 4 patients (44.4%) had mild pain. Therefore, chi-square test revealed no statistically significant differences (Table 3).

Examining Postoperative Patient Satisfaction Level

Among the cohort of patients who received surgical intervention involving the transfer of the trapezius muscle on the ipsilateral side, it was observed that 2 patients (16.7%) reported a favorable, 3 patients (25%) reported high, and 7 patients (58.3%) reported excellent level of satisfaction with the outcome of the procedure. Among the cohort of patients who underwent surgical intervention involving the transfer of the trapezius muscle on the contralateral

Table 2: The Results of Shoulder Range of Motion

Variable			30-60	60-90	>90	
Group	Lateral	Count	3	3	6	12
		% within group	25.0%	25.0%	50.0%	100.0%
		% within abduction of shoulder	60.0%	37.5%	75.0%	57.1%
		% of Total	14.3%	14.3%	28.6%	57.1%
	Contra lateral	Count	2	5	2	9
		% within group	22.2%	55.6%	22.2%	100.0%
		% within abduction of shoulder	40.0%	62.5%	25.0%	42.9%
		% of Total	9.5%	23.8%	9.5%	42.9%
Total		Count	5	8	8	21
		% within group	23.8%	38.1%	38.1%	100.0%
		% within abduction of shoulder	100.0%	100.0%	100.0%	100.0%
		% of Total	23.8%	38.1%	38.1%	100.0%

Chi-Square Tests			
	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2.319[a]	2	.314
Likelihood Ratio	2.370	2	.306
Linear-by-Linear Association	.511	1	.475
N of Valid Cases	21		

Table 3: The Results of Patients' Pain Level

			Pain			Total
			no pain	mild	moderate	
group	Lateral	Count	9	1	2	12
		% within group	75.0%	8.3%	16.7%	100.0%
		% within pain	64.3%	20.0%	100.0%	57.1%
		% of Total	42.9%	4.8%	9.5%	57.1%
	contra lateral	Count	5	4	0	9
		% within group	55.6%	44.4%	0.0%	100.0%
		% within pain	35.7%	80.0%	0.0%	42.9%
		% of Total	23.8%	19.0%	0.0%	42.9%
Total		Count	14	5	2	21
		% within group	66.7%	23.8%	9.5%	100.0%
		% within pain	100.0%	100.0%	100.0%	100.0%
		% of Total	66.7%	23.8%	9.5%	100.0%

Chi-Square Tests			
	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	4.608[a]	2	.100
Likelihood Ratio	5.429	2	.066
Linear-by-Linear Association	.009	1	.926
N of Valid Cases	21		

side, it was observed that 3 patients (33.3%) reported favorable level of satisfaction with the outcome of the procedure. Additionally, 3 patients (33.3%) perceived the result of the operation as good, while another 3 patients (33.3%) regarded it as excellent. The results of the chi-square test indicated that there was no statistically significant distinction between the two groups (Table 4).

Shoulder Function (DASH Score)

In the investigation of postoperative shoulder function among patients who received surgery for trapezius muscle transfer on the ipsilateral side, it was shown that 3 patients (25%) exhibited favorable function, while 6 patients (50%) demonstrated good function, and 3 patients (25%) displayed excellent function. Among the group of patients who received surgical intervention involving the transfer of the trapezius muscle to the contralateral side, 6 patients (66.7%) exhibited favorable function, while 3 patients (33.3%) demonstrated good function (Table 5).

As indicated in Table 5, the analysis of muscle strength among patients who received surgical intervention involving trapezius muscle transfer on the ipsilateral side revealed that 3 patients (25%) exhibited muscle strength level 2, while 7 patients (58%) demonstrated muscle strength level 3, and 2 patients (16%) displayed muscle strength level 4. Among the group of patients who underwent trapezius muscle transfer on the contralateral side, it was observed that 5 patients (55%) exhibited muscle strength level 2, whereas 4 patients (45%) demonstrated muscle strength level 3.

DISCUSSION

Our research has demonstrated the efficacy of trapezius muscle transfer surgery in enhancing shoulder mobility among those afflicted with shoulder paralysis. In circumstances when the utilization of the trapezius muscle on the affected shoulder side is unfeasible, employing the contralateral trapezius muscle serves as a viable substitute to reinstate shoulder mobility.

In the present investigation, there was no occurrence of dysfunction in the healthy shoulder among patients who received surgical intervention involving the transfer of the trapezius muscle from the contralateral side to the injured shoulder. The healthy attachment of the lower portion of the trapezius muscle to the medial border of the scapula is responsible for this phenomenon.

are characterized by their irreversibility and the presence of significant consequences.

Table 4: The Results of Patient Satisfaction after Surgery.

Variable			Satisfaction			Total
			Favarbale	Good	Excelent	
Group	Lateral	Count	2	3	7	12
		% within group	16.7%	25.0%	58.3%	100.0%
		% within satisfaction	40.0%	50.0%	70.0%	57.1%
		% of Total	9.5%	14.3%	33.3%	57.1%
	Contra lateral	Count	3	3	3	9
		% within group	33.3%	33.3%	33.3%	100.0%
		% within satisfaction	60.0%	50.0%	30.0%	42.9%
		% of Total	14.3%	14.3%	14.3%	42.9%
Total		Count	5	6	10	21
		% within group	23.8%	28.6%	47.6%	100.0%
		% within satisfaction	100.0%	100.0%	100.0%	100.0%
		% of Total	23.8%	28.6%	47.6%	100.0%

Chi-Square Tests

	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1.400[a]	2	.497
Likelihood Ratio	1.417	2	.492
Linear-by-Linear Association	1.293	1	.255
N of Valid Cases	21		

Table 5: The Results of Shoulder Function.

Variable	Group	N	Mean	Std. Deviation	Std. Error Mean
Age	Lateral	12	28.4167	10.27316	2.96561
	Contra lateral	9	26.3333	6.85565	2.28522
DASH	Lateral	12	3.0000	.73855	.21320
	Contra lateral	9	2.3333	.50000	.16667
Muscle force	Lateral	12	2.9167	.66856	.19300
	Contra lateral	9	2.4444	.52705	.17568

			DASH			Total
			Favorable	Good	Excellent	
Group	Lateral	Count	3	6	3	12
		% within group	25.0%	50.0%	25.0%	100.0%
		% within DASH	33.3%	66.7%	100.0%	57.1%
		% of Total	14.3%	28.6%	14.3%	57.1%
	Contra lateral	Count	6	3	0	9
		% within group	66.7%	33.3%	0.0%	100.0%
		% within DASH	66.7%	33.3%	0.0%	42.9%
		% of Total	28.6%	14.3%	0.0%	42.9%
Total		Count	9	9	3	21
		% within group	42.9%	42.9%	14.3%	100.0%
		% within DASH	100.0%	100.0%	100.0%	100.0%
		% of Total	42.9%	42.9%	14.3%	100.0%

Chi-Square Tests

	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	4.667[a]	2	.097
Likelihood Ratio	5.768	2	.056
Linear-by-Linear Association	4.444	1	.035
N of Valid Cases	21		

The preoperative utilization of physiotherapy to facilitate passive shoulder mobility is regarded as a significant determinant. In instances when achieving a passive range of motion of at least 80 degrees is unattainable following physiotherapy, it is advisable to immobilize the shoulder.

The utilization of trapezius muscle transfer as a therapeutic intervention for shoulder paralysis resulting from brachial plexus paralysis enables the individual to achieve arm mobility. While the enhancement of shoulder function does not provide sufficient stability to fully stabilize the shoulder joint, the surgical procedure itself is straightforward and characterized by minimal bleeding. Furthermore, the sole contraindication for this procedure is the advanced deterioration of the shoulder joint. Furthermore, the utilization of trapezius muscle transfer can be employed as a supplementary surgical procedure in conjunction with other surgeries to effectively restore optimal upper limb functionality. The transfer of the trapezius muscle to the contralateral side raises several concerns within the field. These concerns encompass potential adverse impacts on the shoulder movements of the unaffected side, muscular ischemia resulting from rotation and stretching, and the patient's acquisition of proficiency in utilizing the transferred muscle on the opposite side. This study found no evidence of movement disorders in the shoulder on the unaffected side. Participants had physiotherapy and training to facilitate shoulder movement.

CONCLUSION

Utilizing the trapezius muscle on the contralateral side as a substitute for the trapezius muscle on the ipsilateral side is a viable alternative with favorable function. In this regard, it is advisable to conduct a study with an extended duration of follow-up or a multi-center study to facilitate a more comprehensive examination. A significant drawback of this study pertains to the limited sample size, which may hinder the generalizability of the findings. Future research with larger sample sizes is warranted to enhance the generalizability of the results.

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CONFLICT OF INTEREST

The authors of this study declare that they have no conflict of interest.

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