Surgical Anatomy of Bicipital Branch of Musculocutaneous Nerve

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Abstract

Twenty patients with brachial plexus injury have been treated with one fascicle nerve transfer to the bicipital branch of the musculocutaneous nerve for reconstruction of elbow flexion. The mean distance from the medial epicondyle to the origin of this branch is 17.9 centimeters. The correlation coefficient and test of statistic significance between distance and heights of patients is 0.76 and 5.07 respectively ($t_{18,\ 0.995} = 2.88$). There is no correlation between the arm span, weight, age and the distance.

The first priority in brachial plexus reconstruction is elbow flexion[1]. Thoughts on neurotization or nerve transfer to create the elbow flexion can be achieved by many kinds of donor nerves. The intercostal nerve transfer[2] is possible to achieve independent action for voluntary elbow flexion. Spinal accessory neurotization for restoration of elbow flexion gains 72.5 per cent of satisfactory biceps recovery[3]. Transferring one fascicle of the ulnar nerve to the bicipital branch of the musculocutaneous nerve to restore elbow flexion in upper arm type brachial plexus injury also achieves grade 4 with flexor power of 5 kg[4]. All of these procedures were performed under basic anatomy of musculocutaneous nerve in which its direct branch to the biceps muscle must be identified first in the operative technique. Exact location of the motor branch to biceps muscle can assist the surgeon in shortening the operative time.

MATERIAL AND METHOD

The group included 18 male and two female patients who had sustained brachial plexus injury and needed elbow flexion restoration. Their ages ranged from 17 to 38 years (mean 27.25 years, SD, 5.43). The height, weight and arm span which was measured from the tip of the acromion process to radial styloid process were recorded. The distances from the medial epicondyle to the proximal original bicipital branch of the musculocutaneous

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nerve were also measured intraopertively. There was one fascicle ulnar nerve transfer to the motor branch of the musculocutaneous nerve[4], fifth and sixth intercostal nerve transfer to the biceps muscle, spinal accessory[5] or phrenic[6] nerve with sural nerve graft transfer to the motor branch of the musculocutaneous nerve or the contralateral seventh cervical root[7] with vascularized ulnar nerve graft transfer to the musculocutaneous nerve were the operative techniques in restoration the elbow flexion for these patients. All patients were healthy and no one had any congenital limb anomalies.

RESULTS

As in Table 1, all study results are shown with the mean distance from the medial epicondyle to the origin of the motor branch of the musculocutaneous nerve being 17.9 cm (range 16.5 to 19.5 cm). The mean height and arm span of the patients were 163.08 cm (range 142 to 172 cm) and 53.4 cm (range 51.5 to 59 cm) respectively. The mean body weight was 58.65 kg (range 39.3 to 95 kg).

As in Table 2, the correlation coefficient and test of significance between the distance and height of patients is 0.76 and 5.07 respectively ($t_{18,\ 0.995} = 2.88$) which indicates significant correlation. There was no correlation between the distance and other parameters.

DISCUSSION

Restoration of elbow flexion is the first priority in brachial plexus injury reconstruction[1]. There are many kinds of operations[8-13] which can provide adequate elbow flexion but direct nerve transfer to the motor branch of the musculocutaneous nerve is the only method that can restore biceps muscle function properly. Intercostal musculocutaneous neurotization yielded a 69.9 per cent success rate as judged by the Medical Research Council (MRC) grade III or more biceps recovery, in the series of 146 adult patients[2]. Spinal accessory musculocutaneous neurotization provided 72.5 per cent of satisfactory biceps recovery (Medical Research Council (MRC) grade III or better)[3].

Table 1. Study results.

No.	Sex	Age	Ht (cm)	Wt (kg)	Arm span (cm)	D (cm)
1.	F	20	154	39.3	53	16.5
2.	M	21	163	67	55	18
3.	M	38	160.5	68.3	56	17.5
4.	M	30	170	65.5	55	18.1
5.	M	17	161	61	56	18.8
6.	M	22	172	53	54	19.5
7.	M	32	166	45	53	18.9
8.	M	32	159	59	54	17.3
9.	M	31	170	69	53	17.8
10.	M	27	161.5	44.5	59	17.5
11.	M	24	165	55.5	52	17.9
12.	M	33	163.5	52.4	56	18.2
13.	M	29	152	55.5	51.5	17
14.	M	23	172	95	59	19
15.	M	26	160	55	49	17.6
16.	F	22	155	42	55	17
17.	M	31	167	64	53	17.9
18.	M	26	159	68	51.5	17.3
19.	M	34	170	52	54	18
20.	M	27	161	62	57	18.2
Mean		27.25	163.08	58.65	54.3	17.9
S.D.		5.43	5.75	12.48	2.49	0.74

* D - The distance from medial epicondyle to the proximal original bicipital branch of musculocutaneous nerve.

Table 2. Correlation coefficient and test of significance between distance and the others.

	Age	Ht	Wt	Arm span
Covariance	-0.44	3.25	3.80	0.59
rxy	-0.11	0.76	0.35	0.32
t	0.48	5.07****	1.59	1.45

****$t_{18, 0.995} = 2.88$

$$rxy = \frac{Sxy}{Sx\ Sy}$$

rxy = Pearson Product Moment Coefficient
Sxy = covariance of X with Y
Sx = standard deviation of X
Sy = standard deviation of Y

$$t = \frac{rxy}{\sqrt{\frac{1-r^2xy}{n-2}}} \quad ; \quad \checkmark = n-2$$

t = *t*-test for significance of rxy
n = sample size (n =20)
✓ = degree of freedom (✓ = 18)

Two types of distribution of the motor branches of the biceps were reported[4]. In the first type, the motor branch of the biceps originated from the musculocutaneous nerve as a common trunk. The common trunk then divied into two branches, one for the short head and anather for the long head. In the second type, the motor branch of the biceps originated from the musculocutaneous nerve at different levels. The branch to the short head originated proximally 11 cm below the acromion. The branch to the long head originated about 2 cm distally. Some degrees of shoulder abduction in order to expose the medial side of the arm effects the distance from the acromion process to the motor branch of the musculocutaneous nerve.

The distance from the medial epicondyle to the proximal motor branch of the musculocutaneous nerve is not influenced by shoulder motion. The medial epicondyle is a prominent subcutaneous bony landmark. Accurate distance can be obtained from the length of the straight line measured from the medial epicondyle to the motor branch of the musculocutaneous nerve. This provides better value than that measured from the acromion process to the motor branch of the musculocutaneous nerve.

The distance from the medial epicondyle to the motor branch of the musculocutaneous nerve significantly correlates with the height of the patient. The mean distance (17.9 cm) corresponds to the mean height of 163.08 cm. This correlation can be used to estimate the distance for a taller patient. This will save the operative time and the minimal dissection in approaching the motor branch of the musculotaneous nerve.

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กายวิภาคประยุกต์ทางศัลยกรรมของแขนงประสาทเลี้ยงกล้ามเนื้อไบเซ็พ

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จากการศึกษาผู้ป่วยรากประสาทแขนบาดเจ็บ 20 ราย โดยวิธีโยกย้ายเส้นประสาทจากบริเวณอื่นต่อเข้ากับแขนงประสาทเลี้ยงกล้ามเนื้อไบเซ็พ ช่วยให้สามารถงอข้อศอกได้ พบว่าระยะห่างระหว่างปุ่มกระดูกอิปิคอนดายล์ด้านในมายังต้นแขนงประสาทเลี้ยงกล้ามเนื้อไบเซ็พ มีค่าเฉลี่ย 17.9 เซนติเมตร ค่าสัมประสิทธิ์สหสัมพันธ์ระหว่างระยะห่างกับความสูงของผู้ป่วยมีค่าเท่ากับ 0.76 เมื่อทดสอบด้วยค่าที มีค่าเท่ากับ 5.07 ($t_{18,\ 0.995}$ = 2.88) ซึ่งมีนัยสำคัญทางสถิติ สำหรับผลการทดสอบความสัมพันธ์ระหว่างระยะห่างกับช่วงแขน น้ำหนักและอายุ พบว่าไม่มีนัยสำคัญทางสถิติ

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