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Original Research Article

Study of Post-Surgical Improvement in Motor Power/Functional Status in Upper Limb in Traumatic Brachial Plexus Injuries

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Abstract:

Aim: The present study aimed to evaluate the clinical characteristics and functional gain of the upper limb in patients who underwent surgical treatment after traumatic brachial plexus injuries along with psychosocial assessment of the patient undergoing treatment.

Methods: Total 32 patients brachial plexus injuries fulfilling the inclusion and exclusion criteria were selected for the present study. Patients were assessed for motor, functional outcomes in preoperative period and then followed up on OPD basis, and 6 monthly basis. Primary outcome evaluation was done by motor outcome and secondary outcome evaluation included the functional and psychosocial outcome.

Results: Mean age of the patients was 24.87 yrs. Good motor outcome was seen in 9 cases (28.12%), 5 cases of which had upper and middle trunk lesions whereas 4 cases had Pan brachial plexus injury. 18 (56.25%) cases in total had poor motor outcome score, most of which had (14) Pan brachial plexus injuries. Out of the 16 early presenters, 4 (25%) had excellent recovery, while 5 (31.25%) had good recovery. In late presenters, only 1 (6.25%) patient had excellent recovery, whereas 3 (18.75%) patients had good recovery. Wilcoxon signed ranks test showed a statistically significant change in preoperative and postoperative pain severity score ($Z = -4.014$, $P < 0.05$). Statistically significant changes were observed in preoperative and postoperative DASH score, physical functioning score, emotional health problems score, vitality score, emotional well-being score, social functioning score, bodily pain score and general health score ($Z = -4.936$, $P < 0.05$).

Conclusion: The study shows that brachial plexus surgery can provide good motor results (43.75%) in some patients, but not in more than 50%. The overall improvement in functional life is significant, and even minimal relief like allaying neuralgic pain (68.75%) and nominal motor function can provide a psychological boost to a broken-down individual from traumatic brachial plexus injury, helping them regain lost confidence.

Keywords: Traumatic Brachial Plexus Injury, Brachial Plexus Surgery.

Introduction

Traumatic brachial plexus injuries are debilitating and lead to motor and sensory deficit, pain, functional limitation and significant alterations to patients' quality of life. They are more prevalent among young adults who have suffered high-energy trauma, especially car accidents. [1–3] Diagnosis is difficult and treatment is complex. The incidence of these injuries is 1.3% in multiple-trauma patients and 5% in motorcycle accident victims. [4] In most of the studies, surgical results were assessed only by means of motor or sensory recovery, [5,6-9] which does not always correlate with functional status. Functional outcomes and quality of life (QOL) were evaluated only in a few series. [10,11,12] The recent development of statistically validated functional and QOL assessment tools has improved the ability of clinicians to quantify these outcomes. [12] According to Kretschmer et al. [11] 87% of patients operated for pan brachial plexus injury were satisfied and 83% would undergo the procedure again. Despite a high satisfaction rate, patients remained considerably disabled and half of the patients were unable to return to work. Thus, there is discordance between patient satisfaction and disability. Despite the fact that brachial plexus injury has low incidence (1.2%) of the inju-

ry in world population, the fact that it is more associated with young male population, and two wheeler riders [13], its prevalence in India can be estimated higher than the world population. There are various studies in literature that compare motor outcome to functional recovery of the patient's undergoing surgery for BPI. However, very few studies have evaluated psychosocial part of the recovery. [12,14] Moreover, the data available on combined functional and psychosocial aspect of the injury and its treatment is still limited. Hence the objective of the present study was to evaluate the clinical characteristics and functional gain of the upper limb in patients who underwent surgical treatment after traumatic brachial plexus injuries along with psychosocial assessment of the patient undergoing treatment.

Material and Methods

This was a prospective observational study on patients who present to the Department of Burns and Plastic Surgery Outdoor patient department (OPD) in MLN Medical College Prayagraj and with post traumatic brachial plexus injuries, hence have undergone surgical treatment at our or other centers. Patient fulfilling the inclusion and exclusion criteria were considered for the present study. Complete details of the demographic data regarding the mode of injury, associated injuries, and time since injury, and complications of procedures if any were recorded.

Inclusion Criteria and Exclusion Criteria: Post traumatic brachial plexus palsy patients of age 18 yrs and above were included. Mentally unstable, patients whose brachial plexus injuries are being managed conservatively and patients with active drug use were excluded from study.

A total of 32 patients were evaluated. Sample size calculation done by processing data of previous studies by PSSC (Power and sample size calculator) software 3.1.6 version.

Patients were assessed for motor, functional outcomes in preoperative period and then followed up on OPD basis, and 6 monthly basis.

Primary Outcome Evaluation: Motor outcome

The baseline motor outcome measurement was assessed by British MRC grading. Excellent motor outcome was graded 4/5 good as 3/5 and poor outcome as <3/5 on the scale.

Secondary Outcome Evaluation: The secondary outcome evaluation included the functional and psychosocial outcome.

A] The functional outcome: The functional outcome was assessed by

1. DASH (Disability of arm shoulder and hand) questionnaire
2. SF-36 (Short form health survey including 36 items) questionnaire
3. VAS (Visual Analogue Score)

Surgical procedures included neurotisation and neurolysis.

Data Collection:

Data was collected by using variable methods like:

1) Assessment of patient functional outcome via DASH, SF-36 and VAS score.
2) Clinical examination for assessment of Range of motion (ROM) via the MRC scale.

Statistical Analysis: Analysis was done by comparing pre and post-operative functional (DASH, SF-36, VAS,) and Wilcoxon signed rank test was utilized.

Results

Out of the 40 patients treated during the study period, 32 patients were included in our study. 8 patients were excluded as 4 were lost to follow up and 3 were under 18 years of age and 1 died due to moribund comorbidities soon after presentation. Out of the 32 patients only 2 (6.25%) were females. Amongst the 32 included the age varied from 18 years to 47 yrs. Maximum 14 (43.75%) cases were encountered in 18 to 22 yrs. age group. Only 4 (12.5%) cases were above 33 years of age. Mean age was 24.87 yrs. Only 5 out of the total had left sided injury, whereas rest had right sided lesions. Out of the 5 left sided lesions, 3 had left hand dominance. Out of 27 right sided lesions, 25 had right hand dominance. Only 4 (12.5%) patients had lesions to non-dominant sides.

Road traffic accident was the predominant aetiology. In most of such cases, victims involved were travelling on two wheelers, 22 (68.75%). Other road traffic accidents involved. Objects falling from height were second most common cause of injury 6(18.75%).

Assault and penetrating injuries contributed to one case each. Patients presented with various associated injuries. Out of which clavicle 8 (25%), humerus 6 (18.75%) and rib 5 (15.62%) fractures were most common in decreasing order of occurrence.

The time since presentation was categorized depending on the duration of presentation, as early (<6months), late (6- 12 months), and delayed (>12 months). Most of the patients (18) presented in late category. 12 presented early and only 2 presented delayed. Mean was 6.8 months.

Depending on the level of lesion, root and trunk involvement in the MRI findings, cases were divided in 4 groups. Upper trunk (UT), upper with middle trunk (UT+MT), and (Pan) where, all levels

were equally involved. Most of the patients had Pan brachial plexus injury 18. 7 cases had UT injury alone. 7 had both UT+MT injury.

All the patients underwent surgical exploration along with neurotisation or neurolysis or both. Neurotisation was performed as single, double nerve transfers. Neurolysis alone was performed only in 2 cases. In 26 cases, only neurotisation was done. In rest of the 4 cases, combination of neurotisation and neurolysis were performed.

Out of the 30 cases, where neurotisation was performed. Single neurotisation was performed in 11 cases while double neurotisation was performed in 19 cases. Single neurotisation was done in partial BPI cases where either shoulder abduction or elbow flexion was deficient.

Neurotisation mainly targeted shoulder abduction and elbow flexion. For shoulder abduction, spinal accessory nerve (SAN) and phrenic nerve (PN) were most commonly utilized as donor nerves (SAN 22 cases and PN 4 cases). Whereas, Suprascapular (SS) and axillary nerve (AN) were most common recipient nerves (SS 20 cases and AN 6 cases). Similarly, for elbow flexion, intercostal nerve (ICN) and ulnar nerve fascicles (UN) were frequently used as donor nerves (ICN 17 cases, UN 6 cases). On the other hand, lateral cord (for innervation of musculocutaneous nerve) was used as recipient nerve in 17 cases requiring elbow flexion, ulnar nerve fascicle to musculocutaneous anastomosis (Oberlin transfer) was done in 6 cases.

Interposing sural grafts were used in 2 cases where excessive scarring was present.

Motor outcome was compared in patient grouped depending on lesion or level of injury (Partial/ Pan BPI), type of surgical procedures performed and duration between injury and time of surgery (time of presentation). Motor outcome was assessed by British MRC grading. Excellent motor outcome was graded 4/5 good as 3/5 and poor outcome as <3/5 on the scale.

Motor Outcome Scores vs type of lesion

In partial BPI, those cases with either upper trunk (UT) and combination of Upper and Middle trunks (UT+MT) involvement, excellent outcomes were noted only in 5 cases (15.6%). 3 had only UT and 2 had UT+MT injury.

Good motor outcome was seen in 9 cases (28.12%), 5 cases of which had upper and middle trunk lesions whereas 4 cases had Pan brachial plexus injury. 18 (56.25%) cases in total had poor motor outcome score, most of which had (14) Pan brachial plexus injuries.

Table 1: Motor Outcome Scores vs type of lesion

	Excellent	Good	Poor	Total
UT	3	2	2	7
UT+MT	2	3	2	7
Pan	0	4	14	18
Total	5	9	18	32

Motor Outcome Scores vs. type of surgery: Out of 2 patients who underwent only neurolysis, one had only UT lesion whereas one had UT+MT lesion. Outcome was good in earlier and poor in later patient. Outcome was good in both of the patients in which combination of neurotisation and neurolysis was performed. Both of the patients had only UT lesions. In rest (28) of the patients, where only neurotisation was performed, 5 had excellent 9 had good and 18 had poor outcome.

Table 2: Motor Outcome Scores vs type of surgery.

	Excellent Outcome	Good Outcome	Poor Outcome	Total
Neurolysis	0	1	1	2
Neurolysis with neurotisation	0	2	0	2
Neurotisation	5	6	17	28
Total	5	9	18	32

Motor Outcome Scores vs Time of presentation (Duration between injury and surgery): Patients were classified according to the time lapse between injury and actual time of surgical intervention as early (<6months), late (6months to 12 months) and delayed (>12months) presenters. Out of the 16 early presenters, 4 (25%) had excellent recovery, while 5 (31.25%) had good recovery. In late presenters, only 1 (6.25%) patient had excellent recovery, whereas 3 (18.75%) patients had good recovery.

In delayed presenters, 2 patients operated (after 12months), underwent Oberlin's transfers. Only 1 had good recovery.

Table 3: Motor Outcome Scores vs Time of presentation (Duration between injury and surgery)

	Early (<6months)	Late (6months to 12 months)	Delayed (>12months)	Total
Excellent	4	1	0	5
Good	5	3	1	9
Poor	7	10	1	18
Total	16	14	2	32

Neuralgia or neuropathic pain was present in 22 (68.75%) of our patients.

These patients usually required medications for the symptom. Pain score was recorded with pain visual analogue scale (VAS). The VAS score was divided in three grades:

- Severe (9-10) 9
- Moderate (6-8) 10
- Mild (3-5) 3

Mean of preoperative pain was 7.68 and mean postoperative pain score was 3.40 after 6months of duration. Out of the 22 patients, 9 had severe, 10 had moderate and 3 had mild pain score. After surgical intervention, only 2 had severe, 4 had moderate, and 5 had mild pain scores while 11 had no pain or minimal pain score. All patients with Pan BPI had severe to moderate pain scores. Wilcoxon signed ranks test showed a statistically significant change in preoperative and postoperative pain severity score (Z = -4.014, P <0.05).

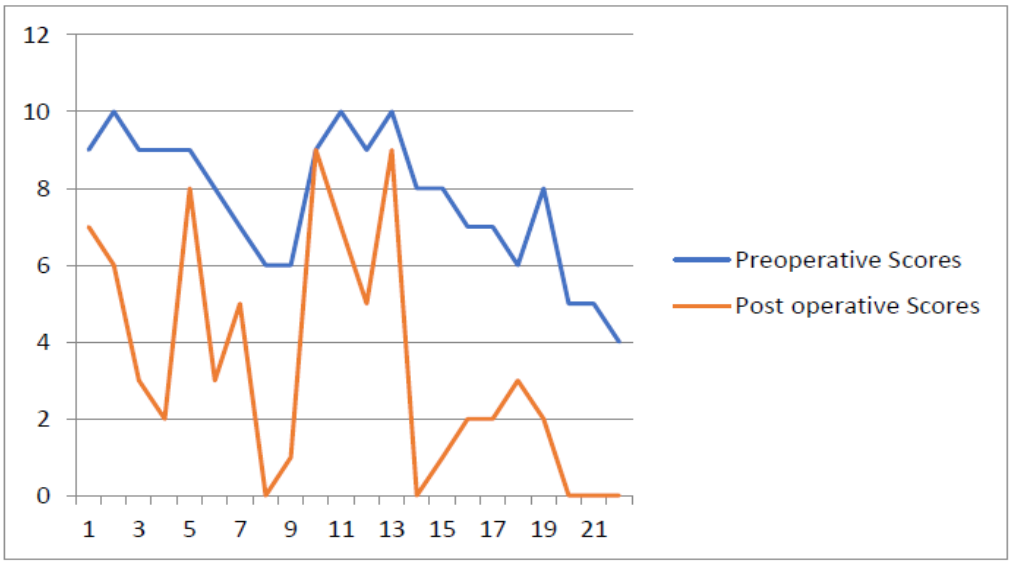

Figure 1: Line diagram showing preoperative and postoperative pain severity score

Table 4: DASH score compared to motor outcome score

Motor Outcome Score	DASH Score	
	Mean score in Pre-Operative Cases	Mean score in Post-Operative
Excellent (n=5)	85.8	60.2
Good (n=9))	86.7	61.3
Poor (n=18)	95.2	84.8

Wilcoxon signed ranks test showed a statistically significant change in preoperative and postoperative DASH score (Z = -4.936, P <0.05).

Table 5: Physical functioning score compared to motor outcome score.

Motor Outcome Score	Physical Functioning Score	
	Mean score in Pre-Operative Cases	Mean score in Post-Operative
Excellent (n=5)	52.0	63.0
Good (n=9))	50.1	59.6
Poor (n=18)	49.5	57.2

Wilcoxon signed ranks test showed a statistically significant change in preoperative and postoperative physical functioning score (Z = -4.936, P <0.05).

Role limitations due to physical health problems:

Table 6: Physical health problems score compared to motor outcome score.

Motor Outcome Score	Physical health problems Score	
	Mean score in Pre-Operative Cases	Mean score in Post-Operative
Excellent (n=5)	51.0	67.0
Good (n=9))	51.7	60.3
Poor (n=18)	52.4	57.7

Wilcoxon signed ranks test showed a statistically significant change in preoperative and postoperative Physical health problems score (Z = -4.616, P <0.05).

Role limitations due to emotional health problems:

Table 7: Emotional health problems score compared to motor outcome score.

Motor Outcome Score	Emotional health problems Score	
	Mean score in Pre-Operative Cases	Mean score in Post-Operative
Excellent (n=5)	53.4	73.2
Good (n=9))	53.0	70.3
Poor (n=18)	53.8	66.8

Wilcoxon signed ranks test showed a statistically significant change in preoperative and postoperative emotional health problems score (Z = -4.936, P <0.05).

Table 8: Vitality score compared to motor outcome score.

Motor Outcome Score	Vitality score	
	Mean score in Pre-Operative Cases	Mean score in Post-Operative
Excellent (n=5)	34.8	49.8
Good (n=9))	35.6	49.0
Poor (n=18)	36.3	45.6

Wilcoxon signed ranks test showed a statistically significant change in preoperative and postoperative vitality score (Z = -4.936, P <0.05).

Table 9: Emotional well-being Score compared to motor outcome score

Motor Outcome Score	Emotional well-being Score	
	Mean score in Pre-Operative Cases	Mean score in Post-Operative
Excellent (n=5)	38.4	57.2
Good (n=9))	35.3	53.6
Poor (n=18)	36.1	51.0

Wilcoxon signed ranks test showed a statistically significant change in preoperative and postoperative emotional well-being score (Z = -4.936, P <0.05).

Table 10: Social functioning score compared to motor outcome score

Motor Outcome Score	Social functioning Score	
	Mean score in Pre-Operative Cases	Mean score in Post-Operative
Excellent (n=5)	25.4	43.8
Good (n=9))	26.8	44.3
Poor (n=18)	27.5	41.3

Wilcoxon signed ranks test showed a statistically significant change in preoperative and postoperative social functioning score (Z = -4.936, P <0.05).

Table 11: Bodily Pain Score (according to SF-36 questionnaire) compared to motor outcome score.

Motor Outcome Score	Bodily Pain Score	
	Mean score in Pre-Operative Cases	Mean score in Post-Operative
Excellent (n=5)	31.6	58.6
Good (n=9))	33	57.4
Poor (n=18)	31.3	56.5

Wilcoxon signed ranks test showed a statistically significant change in preoperative and postoperative bodily pain score (Z = -4.936, P <0.05).

Table 12: General Health Score compared to motor outcome score.

Motor Outcome Score	General Health Score	
	Mean score in Pre-Operative Cases	Mean score in Post-Operative
Excellent (n=5)	37.8	58.2
Good (n=9))	36.2	56.4
Poor (n=18)	35.7	55.7

Wilcoxon signed ranks test showed a statistically significant change in preoperative and postoperative general health score (Z = -4.936, P <0.05).

Discussion

Brachial plexus injuries are mostly seen in young healthy adults who constitute the active workforce and usually are young earning members of the family. The loss of function of limb not only greatly affects social and professional life of the victim but also the dependent family members. While treating such patients, objective findings of the patients like muscle strength and sensory performance are given undue importance and subjective symptoms like pain or feeling of well-being are usually ignored. Despite the status of motor function of limb, severe neuralgia can impair the quality of life of such patients. Many a times, an otherwise weak but functional limb helps patients to mask the stigma of being a disabled person. Thus, when evaluating the success of any surgical intervention in BPI lesions, various subjective changes like pain severity, emotional feeling of disability, and improvement in overall quality of life should also be evaluated.

As previously stated, majority of the patients affected are young males, and females form a very small percentage. This study also reflected the same demographics, where (93.75%) males and only (6.25%) were females. Prasad L, Sinha S et.al in their study on traumatic brachial plexus injuries also had a male predominance, however, slightly higher (11%) percentage of female patients. [14]

Maximum 14 (43.75%) cases were encountered in 18 to 22 yrs. age group. Only 4 (12.5%) cases were above 33 years of age. Mean age was 24.87 yrs. The other studies in India on BPI however had a mean of 27 yrs. that was slightly higher than ours. [14,15] However, in yet another Indian study by Bhandari PS et al. also had a lower mean age group of mean 25.7 years. [15]

Road traffic accident was the major cause in our study, where two wheelers constituted 68.75% cases, whereas other vehicular traffic accounted for just 6.25% cases. Barman et al and Prasad L et al had a higher percentage of 75% whereas, Thatte MR et al had even higher proportion at 86%. [14,16,17] Gunshot injuries and snowmobile injuries were the other common modes of injury that have been reported previously by Kim et al. and Midha R et al., respectively, but have not been among the etiologies in our series, probably due to geo-social factors in India. [15,18]

Our study had total of 27 (84.34%) right sided and 5 (15.62%) left sided lesions. Amongst them 28 (87.5%) were having dominant hand lesions. This finding echoed with study by Jain DK et al. [19]

We had ipsilateral calvicle fracture in 8 (25%) cases, as most common associated injury and fracture ipsilateral humerus in 6 (18.75%) cases, as second most common injury. Similarly, Bhandari PS et al had clavicle fracture as most common associated injury in 15% cases.20 Conversely, Barman A et al had humerus fracture as most common associated injury, in about 50% cases. [16]

Different studies report time interval from injury to surgical intervention as an important aspect. In our study, there were only 12 (37.5%) cases who presented in time i.e. early presenters (< 6 months) duration. Whereas, maximum of 18 (56.25%) cases ended up as late presenters (6 - 12 months). The mean interval was 6.8 months. This was longer as compared to various studies by Jain et al, Thatte et al and Bhandari PS et al where mean time of presentation was 4.25 months, 5.12 months and 4.2 months respectively. [17,19,20] However, in two studies by Prasad et al and Ahmed et al, have reported such longer intervals with mean time of presentation at 8 months and 7.5 months respectively. [14,12] We also had a higher proportion (56.25%) of late presenters (6 -12 months of injury) as compared to within 6 months of injury (37.5%). This is in contrast to study by Ahmed et al. [12] This late presentation of our patients might be due the fact that ours being a hilly state, remote population has limited access to our facility. Also, lack of knowledge among the patients and referring physicians could be one of the reasons. Yet another one could be, ours being a tertiary care centre, delayed referral though India's weak public health system, leads to late patient presentation.

Surgery in BPI is indicated if there are no signs of clinical/electrophysiological (NCV nerve conduction velocity and EMG electromyography) recovery after 3 months of injury. The type of surgical procedure: neurotisation or neurolysis depends upon condition of the nerves during surgery. If nerves are stimulable intra-operatively and are found to be in continuity, then a simple neurolysis would suffice while neurotisation might be required in rest of the cases. In our study, only 4 patients underwent neurolysis: 2 with neurotisation and 2 neurolysis

alone. Whereas, all other underwent neurotisation only. Other studies by Thatte et al show higher percentage of patients undergoing neurolysis. [17] However, in study by Prasad L et al, similar lower percentage of patients underwent neurolysis. [14] This could be due to the fact that, like ours, study by Prasad et al was also conducted at tertiary care center and received more patients in delayed (6 -12 months) category.

In patients who underwent neurotisation, nerve transfers were done depending on patients requiring shoulder abduction or elbow flexion or both. Spinal accessory nerve [21] was the most frequently used donor nerve and suprascapular 22 (20) was most frequently used recipient nerve. This was also echoed in various studies. [14,20,23]

High incidence of using this transfer has been summarized by Siqueira MG et al in following four points:

It is a nerve almost entirely motor; High number of motor fibers (roughly 1700);

Similar functional characteristics to those of the suprascapular nerve; Close proximity to the suprascapular nerve; and, its integrity is preserved in almost 95% of patients with traumatic brachial plexus palsy. [23]

For elbow flexion, intercostal nerve (ICN) was the most common donor and lateral cord as a recipient for innervation of musculocutaneous nerve (MCN) was the most common nerve transfer (17 cases) for infraclavicular lesions. Similarly, Das KK et al and Moiyadi et al in their studies used ICN to MCN as most common transfers, due to close proximity, multiple donor sites, better results due to constant stimulation due to on-going respiration (like phrenic nerve), no need for interposing graft. [24,25] Kovachevich R in his study describes the viability of ICN in case of rib fractures, contradicting the long standing belief, however, as described before, harvesting ICN from fracture zone can be complicated by pleural tear due to dense fibrotic adhesions, as happened in 1 of our case. [26] In different studies, motor outcome in BPI has been found to have been dependent on mainly 2 aspects, time interval between injury and surgery (time of presentation) and level or type of lesion (better in partial upper trunk lesions), however no such corelation existed between the motor outcome and type of surgery performed. [14,17,19,20] This has been amply reflected in our study, where excellent to good motor recovery was present in 10 cases (71.42%) of the 14 operated whereas, only 4 (22.22%) had good recovery out of the pan BPI operated. Thatte et al in their study, had about 70% good recovery in upper trunk lesions while in global plexopathies (Pan BPI) this good outcome was present only in about 20% cases. [17]

Depending on time of presentation, excellent to good recovery was appreciated in 9 (56.25%) out of 16 cases who presented timely (<6 months). This outcome fell to only 4 cases (28.57%) in patients who presented late. Similar results were obtained by Prasad et al and Ahmed et al where delayed nerve transfers yielded poorer results. [14,12]

In delayed cases (>12months) with partial plexus injury, ulnar nerve (UN) fascicles were transferred to musculocutaneous nerve (MCN), also called as Oberlin's transfer. Our study included only 2 of such cases. Despite good results obtained by various studies [14,17,27,28] we had good result in only one of our patients. This could be due to small sample size of this procedure.

Neuropathic pain in BPI is characteristic and at times unrelated to severity of lesion. That is why many patients of pan BPI never encounter such pain; whereas patient's minimal lesions also have severe debilitating pain. It can be episodic in nature or can be continuous. Though medications like gabapentin do provide some relief but at times, patients experience deranged sleep pattern because of night pain, which adversely affects their QOL. [29,30] The reduction in neuropathic pain after surgery (neurolysis or nerve transfer) is attributed to removal of compressive scars, and painful neuromas. [31] Though many studies have described pain in BPI, few have analyzed the QOL changes that occur after patients are treated. [29,32] the main lacuna of these study models is that researchers did not compare the improvement in pain management in preoperative and post-operative groups, which very critical to assess the impact of surgery on pain.

In a recent study, Gonzalo B et al have used an integrated pain scale to assess the severity in preoperative and post-operative group. They noticed that patients who underwent microsurgical procedure for BPI, 74.5% had neuropathic pain and 57% had pan BPI. There was a significant reduction in pain in post-operative cases. [29] in our study, we evaluated pain by VAS (Visual Analog Scale). The patients' pain was assessed both preoperatively and OPD follow up visits. A final pain score was recorded at the end of 6 months. Compared to Gonzalo's study, we had 22 cases (68.75%) of BPI with pain, and out of these 22 cases 11 (68%) had pan BPI. Out of 22 patients 14 (63.63%) patients had no or mild episodes of pain. Only 3 patients continued to have severe pain but episodic in nature. Rest all other patients had notable relief in pain after surgery ($p<0.05$). Ahmed L et al showed that pain relief was better in patients operated within 6 months of injury; however, such differences were not noted in our study. [12] The improvement in the emotional well-being even in patients who had no motor recovery might have also been contributed by the pain relief. This prospective study clearly

highlights a significant relief in pain in addition to improvement in the functional QOL and psychosocial aspects after surgical treatment of these lesions.

Apart from VAS score for pain, DASH questionnaire was used as another indicator of functional improvement in these patients. This is a 30-item; self-report questionnaire designed to measure physical function and symptoms in people with upper limb conditions was filled up. Higher scores indicate more disability. The DASH score mean for our study was 91.4 in preoperative cases, whereas that in post-operative cases was 74.37 ($P<0.05$). This was significant reduction in disability post-surgical patients' score. Prasad L et al [14] divided the DASH score in those improved on motor scale 33 and those who did not improve after surgery. Significant improvement was seen in both groups in DASH score. Thus, despite patients that had minimal or no motor improvement, were far off better functionally.

Third and last indicator of functional improvement was SF-36 questionnaire, that consisted of 36 questions further divided in 8 subgroups (physical functioning, social functioning, role limitations due to physical problems, role limitations due to emotional problems, mental health, bodily pain and general heath perception by the patient). Unlike DASH, higher scores indicate better results. Study by Prasad et al, patients scored higher in post-operative group except in physical functioning and physical role limitations group.

Whereas in study by Ahemd et al, all groups demonstrated high scores without any differentiation. [12] Our study also, showed statistically significant higher scores in post-operative patients in all 8 subgroups ($p<0.05$). Physical functioning, social functioning, role limitations due to physical problems, role limitations due to emotional problems, mental health, bodily pain general health and vitality. The mean scores in all subgroups scored higher not only in cases with excellent Motor Outcome Score (MRC grading) [33] but also in poor Motor Outcome Score cases. Indicating, improved functional results despite minimal motor gain.

Conclusion

This study gives an elaborate account of various nerve microsurgeries and nerve transfers that can improve patients' quality of life. Traditional way of assessment of motor function, tends to downplay the benefits of these surgeries. Complications like seroma and skin flap necrosis that could be encountered during BPI surgery. They can be easily avoided with due care.

Even with the latest advancements of the brachial plexus surgery, full restoration of the limb function is still not achievable. This study entails, that surgical option (neurotisation and neurolysis) can give good (43.75%) motor results in some patients. Though, the motor regain is not achievable in more than 50% patients, the overall improvement in functional life of the patient can't be underplayed. In this scenario, even minimal relief that the surgical option provides like allaying of neuralgic pain (68.75%), and nominal motor function provides a great psychological boost to a broken-down individual helping him regain the lost confidence.

This study also elucidated the role of surgery in late presenting patients and that surgical option should be offered to all patients irrespective of duration of injury.

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