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Original Article

Orthopaedics Section

Factors that Predict the Response to Treatment in Carpal Tunnel Syndrome

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ABSTRACT

Introduction: Carpal tunnel release is a very common surgery and most people do very well after the surgery but some pre-existing conditions can have a negative impact on the outcome of the surgery. Our current knowledge about the impact of these conditions on the outcome of carpal tunnel release is incomplete.

Aim: To find out the various factors that could affect the outcome of the carpal tunnel release.

Materials and Methods: The present study was a retrospective analysis of the patients who underwent open carpal tunnel decompression and the study evaluates the effect of pre-existing factors like age, sex, duration of symptoms, BMI, Nerve Conduction Studies (NCS), alcohol, smoking status and comorbid conditions like diabetes, depression and fibromyalgia on the outcome of surgery. Chi-square analysis was carried out to find out the relationship between the final outcome and each variable. A p-value <0.05 was considered as significant.

Results: Age, sex, duration of symptoms, BMI, NCS, alcohol and smoking status and comorbid conditions like diabetes, and depression were not found to be associated with the outcome. Fibromyalgia was found to be significantly associated with poor outcome.

Conclusion: Carpal tunnel release consistently gives good outcomes and must be offered to the patients who have failed conservative treatment, irrespective of the factors like age, sex, duration of symptoms, BMI, NCS, diabetes, and depression. Patients with fibromyalgia must be warned pre-operatively about the possibility of inferior results following the surgery.

Keywords: Carpal tunnel release, Fibromyalgia, Outcome, Retrospective study

INTRODUCTION

Carpal tunnel syndrome is the most common peripheral nerve problem and has considerable employment and healthcare costs. Surgical release of the transverse ligament is considered the definitive treatment of carpal tunnel syndrome. Phalen stated: “There are few operations that are as successful and rewarding both to the patient and to the surgeon as operation for CTS [1]. In reality, most patients do very well after surgical release, but there has been disagreement among hand surgeons about the expected outcome [2].

It seems possible that pre-existing factors in a patient’s history or in the aetiology itself may not only contribute in the onset of the syndrome but may also influence the outcome of the surgical treatment.

There have been many studies looking into the factors that can predict the outcome of the surgery but most of them have conflicting inferences [3-7]. Moreover, most studies have looked into just one or two factors [8-10]. At present there are not enough studies that could enable us to predict the outcome of carpal tunnel surgery before going ahead with the surgery [11].

This study examines various factors that can predict the response to surgery in CTS. This includes an analysis of medical records of the patients who underwent carpal tunnel decompression in order to document various factors which could have an influence over the outcome. Using the statistical methods, the significance of each factor in influencing the outcome was evaluated.

This study would help to determine whether any link can be found between pre-existing conditions and the outcome of treatment. Such conclusions may assist the treating surgeons and their patients by developing more accurate expectations of outcome and in making decisions about whether to proceed with the surgery.

MATERIALS AND METHODS

This study was conducted at Tayside Orthopaedic Rehabilitation and Trauma Centre (TORT), in Ninewells Hospital, Dundee, UK. Retrospective analysis of case records of 36 unilateral and 15 bilateral who underwent primary carpal tunnel decompression from January 2002 to December 2005 was done. The sample size was calculated whilst keeping the power of study at 80%. The patients were identified from the operating lists of the two hand surgeons in the department of Orthopaedics, from the operation theatre database of Tayside Hospital NHS Trust. The case notes of these patients were then collected from the record section of the hospital. Both surgeons used the same surgical technique and follow up protocol and all the patients were operated under local anaesthetic. Patients who had been treated with methods other than open release of carpal tunnel (splinting, steroid injection into carpal tunnel, endoscopic carpal tunnel decompression) and who underwent revision surgery were not included in the study.

Outcome Assessment

All the patients included in the study were followed-up for at least two years and the final outcome was assessed by categorising the patients as recommended by Clarke AM and Stanley D as follows [12]:

- Excellent, which implied complete resolution of symptoms.
- Good, which signified that the patient had significant improvement of symptoms and they felt that their residual symptoms did not warrant any additional medical or surgical treatment.
- Poor, where symptoms were minimally improved, unchanged or worse after surgery.

Patients classified as excellent or good were considered to have a satisfactory outcome. Poor results were considered to be unsatisfactory.

Criteria for Analysis

The pre-operative analyses concentrated on the following factors to determine if any could be shown to affect the surgical outcome: (1) age; (2) sex; (3) obesity; (4) occupation; (5) Duration of symptoms; (6) Smoking and alcohol status; (7) Nerve conduction studies; (8) Co-morbid conditions (diabetes, hypothyroidism, depression, and fibromyalgia) which were included in the study based on the their proven association with CTS in current literature [3-5,8,9].

Body Mass Index (BMI) was used to measure obesity with weight expressed in kilograms and height in metres. Normal BMI was defined as 20 to 25, mildly obese as 25 to 30, moderately obese as 30 to 40 and severely obese as greater than 40 [5].

Occupation was graded as follows: (1) Heavy work, i.e., strenuous physical labour or use of vibratory tools; (2) Medium work, involving repetitive manual work such as assembly line; (3) Light work, involving clerical work, retired people [5].

Patients were categorised according to whether they were Drinking alcohol more than two units per day at the time of surgery. Smoking status was categorised if they were smoking at the time of surgery or if they had quit less than six months previously and non-smoker if they never smoked or had quit more than six months ago [4]. Duration of symptoms were categorised as less than six months, 6-12 months and more than 12 months [13]. With regards to nerve conduction studies patients were categorised positive or negative.

The collected data was thoroughly examined for the associated factors under consideration along with the outcome.

STATISTICAL ANALYSIS

Chi-square analysis was carried out to find out the relationship between the final outcome and each variable. Significance level used was 5%. SPSS software (version 16.0) was used for the statistical analysis. A p-value <0.05 was considered as significant.

RESULTS

Out of total 66 hands, those with excellent or good outcomes constituting the 'satisfied' group were 55 (83.3%) and the hands with poor outcome constituting the 'unsatisfied' group were 11 (16.6%). Demographic details of the patients have been summarised in [Table/Fig-1].

Sex

Three (17.6%) hands with poor outcome were males (out of 17 male hands) and 8 (16%) were females (out of 49 female hands). So, males had 18% poor results whereas, females had 16.3% poor results. This difference was not statistically significant (p-value: 0.6).

Age

There were 7 (13.2%) poor outcomes from the group of <70 years and there were 4 (30.7%) poor outcomes from older group (>70 years). This difference was not found to be statistically significant (p-value: 0.3).

BMI

There were 2 (14.2%) poor outcomes in patients with BMI 20-25, 3 (13.6%) poor outcomes in BMI group of 25-30, 5 (20%) in BMI group of 30-40, and 1 (20%) poor outcome in BMI group >40. No statistical significant difference was found in outcome in different BMI groups.

Duration of Symptoms

There were 10 (19.2%) poor outcomes in the >12 months duration category, 1 (12.5%) poor outcome was from 6-12 months duration category. No hand with poor outcome belonged to <6 months duration category. Duration of symptoms of two cases was not known. Statistically significant difference was no found between the three groups.

Factor		Total number of hand	Patients with excellent/good outcome	Patients with poor outcome	p-value
Sex	Male	17	14	3	0.6
	Female	49	41	8	
Age	<70	53	46	7	0.3
	>70	13	9	4	
BMI	20-25	14	12	2	0.22
	25-30	22	19	3	
	30-40	25	20	5	
	>40	5	4	1	
Duration of symptoms	<6 months	4	4	0	0.45
	6-12 months	8	7	1	
	>12 months	52	42	10	
Occupation	Light	46	39	7	0.08
	Medium	14	12	2	
	Heavy	5	3	2	
Smoking	Smoker	18	15	3	0.09
	Non-smoker	45	37	8	
Nerve conduction studies	Positive	47	39	8	0.1
	Negative	5	4	1	
	Not done	14	12	2	
Alcohol consumption	Yes	7	5	2	0.6
	No	59	50	9	

[Table/Fig-1]: Showing demographic details of the patients with p-values of association of various factors and outcome of surgery
Chi-square test was used for statistical analysis.

Occupation

In the light work category 7 (15.2%) hands were there with poor outcome, whereas, 2 (14.2%) hands had poor outcome in medium work category. There were 2 (40%) poor outcomes in heavy work category. Occupation of one patient was not known. There was no statistical difference between the different occupation categories.

Smoking

There were 16.6% (3 out of 18) poor outcomes in smokers as compared to 17.7% (8 out of 45) poor outcomes in non-smokers. The smoking status of 3 cases was not known. The difference between the two groups was not statistically significant.

Nerve Conduction Studies

There were 8 (17%) poor outcomes out of 47 hands with positive nerve conduction studies, 1 (20%) poor outcome out of five hands with negative nerve conduction studies and there were 2 (14.2%) poor outcomes out of 14 hands where nerve conduction studies were not performed. The association of any of the categories with outcome was not found statistically significant.

Alcohol Consumption

The incidence of poor outcome was slightly higher in patients who were taking alcohol (28.5%, 2 out of 7) than in patients who were not taking regular alcohol (15.2%, 9 out of 59). However, no statistically significant association was found between either of the two groups and the outcome.

Comorbid Conditions

There were 5 (55.5%) poor outcomes in 9 hands with fibromyalgia, as compared to 6 (10.5%) out of 57 in cases without fibromyalgia. Fibromyalgia was found to be strongly associated with poor outcomes (p-value of 0.001).

In the cases with depression as a comorbid condition, the poor outcomes were 2 out of 6 (33.3%) and case without depression the poor outcomes were 9 out of 60 (15%). This difference was not statistically significant.

Out of 12 hands with associated hypothyroidism 3 (25%) had poor outcomes whereas, 14.8% (8 out of 54) hands without associated hypothyroidism had poor outcomes. The difference between the two groups was not statistically significant.

In the hands with associated diabetes, 11.1% (1 out of 9) had poor outcome and 17.5% (10 out of 57) had poor outcomes in those without associated diabetes. The difference between the two groups was not statistically significant. The association of comorbid conditions with outcome is summarised in [Table/Fig-2].

Comorbid condition	Excellent and good	Poor	p-value
Fibromyalgia	4	5	0.001
Depression	4	2	>0.05
Hypothyroidism	9	3	>0.05
Diabetes mellitus	8	1	>0.05

[Table/Fig-2]: Showing association between comorbid conditions and outcome. Chi-square test was used for statistical analysis.

DISCUSSION

This retrospective study was carried out to look into the predictors of the outcome of carpal tunnel surgery. The final outcome was excellent or good (satisfied group) in 83% hands and poor in 17%. The percentage of satisfied group was 78% in Phalen's study [1]. Similarly in the study by Rege AJ and Sher JL [14], the percentage of satisfied patients was 73%. On the other hand the proportion of satisfied patients was as high as 97% in the study by Longstaff L et al., [15].

Age

No statistically significant difference was found between the outcomes of the patients older than 70 and the younger patients, although, the percentage of poor outcome was higher in older group. On closer observation it was also noted that the ratio of good results to excellent results among the satisfied group was higher in older category than in younger category. This indicates that older patients may have been partially relieved from their pre-operative symptoms but, were still satisfied with the outcome of surgery. Similar findings were highlighted by Hobby JL et al., Leit ME et al., Katz JN et al., and Tomaino MM and Weiser RW also could not find any difference in the outcome of younger and older patients [10,4,2]. On the other hand Porter P et al., in their study found inferior results in older patients and they considered age as a factor affecting the outcome of carpal tunnel decompression but they still recommended surgery for older patients [16]. Thus, patients older than 70 years should not be deferred from the surgery if their symptoms are severe enough to justify surgery. However, they should be cautioned that they may have partial relief of symptoms.

Sex

The incidence of CTS was much higher in females than in males and about three-fourth of the patients were females but, sex of the patient did not seem to have any impact over the outcome. These findings corroborate with the findings of the study by Hobby JL et al., and Katz JN et al., [4,8]. So, patients should be offered surgery irrespective of their sex.

BMI

The present study showed that a higher proportion of carpal tunnel patients were overweight (79%) as compared to 38% of the population in the U.K. (The information centre, 2008) [17]. Karpitskaya Y et al., found higher incidence of CTS in obese patients than controls in their study [18]. However, it is not appropriate to draw conclusions from the present study without considering the demographics of the local population. No association was found between BMI and outcome of surgery which agrees with the findings of Yu GZ et al., [5]. Thus, obesity maybe one of the factors associated with the aetiology of CTS but obesity per se does not affect the outcome.

Occupation

There was no statistically significant difference in the outcomes of different occupation categories; although, the poor outcomes were higher in hands with heavy occupation. This is similar to the study of Bostromet L al., which showed that patients exposed to heavy vibration tools have similar results to those who are involved in lighter occupations [9]. Katz JN et al., and Al-Qattan MM et al., on the other hand found significantly inferior results in patients who performed heavy and repetitive work but, these studies have also mentioned involvement of worker's compensation [3,4].

The association of poor outcome with heavy occupation is still controversial. Earlier studies, that found this association significant, have not been able to comment whether this association is due to the occupation itself or due to involvement of worker's compensation. This needs further investigation.

Duration of Symptoms

There was gradual rise in the poor results in the three groups from less than 6 months to greater 12 months symptom duration but this rise was statistically insignificant. Similar results were published by Choi FJ et al., Lonstaff L et al., Al-Qattan MM et al., and Burke FD et al., who opined that patients do well regardless of the duration of symptoms [19,15,3,13]. Yu GZ et al., on the contrary found that patients with duration of symptoms less than six months had slightly lower chance of good recovery but they related this to smaller number of patients in their series [5]. Consequently, patients should be offered surgery if needed, irrespective of the duration of the symptoms.

Smoking and Alcohol Consumption

In the present study, no association was found between the outcome and smoking status. Similarly no association was found with alcohol consumption. This is in disparity with the study of Katz JN et al., who found smokers had worse functional outcomes than non-smokers [4]. They also found alcohol consumption as a strong predictor of lower satisfaction. This needs a further study to explain the association between the smoking and alcohol consumption and outcome in carpal tunnel surgery more clearly.

Nerve Conduction Studies (NCS)

There was no difference between the outcome of the surgery in patients with positive NCS and the patients with negative NCS. This corroborates with the results of Al-Qattan MM et al., Choi SJ et al., Porras AFD et al., who did not find any difference in outcome of surgery for patients with severe neuro-physiological deficits than for those with none [3,19,20]. Thus, nerve conduction studies should probably be considered an added diagnostic tool only and not a predictor of outcome of surgery.

Diabetes

Present study did not show any association between diabetes and poor outcome in carpal tunnel surgery. This seems to be against logical thinking but previous studies by Choi SJ et al., Al-Qattan MM et al., and Mondelli M et al., also concluded that the presence of diabetes does not affect the surgical result of CTS [19,21-23]. However, Ozkul Y et al., suggested that the improvement in diabetics was inferior to non-diabetics and suggested this could be due to the difference in the pathogenesis of CTS in diabetic

patients [24]. The reason for their findings being different from other studies could be because of different assessment methods, population differences or difference in case numbers. Overall, it can be suggested that diabetics with CTS improve after surgery but some intrinsic metabolic disturbances like hyperglycaemia should also be kept under control along with the surgery to reduce complications like infection.

Depression

Poor outcomes were more common in patients with depression than other patients but this difference was not statistically significant. This agrees with the study by Hobby JL et al., who suggested no association between pre-operative psychological disturbance and the outcome of carpal tunnel release [25]. Katz JL et al., had a different opinion and they suggested that poor mental health status was significantly associated with dissatisfaction post operatively [4]. Many of these patients got vague and exaggerated symptoms, and symptoms overlapping with other psychosomatic symptoms, making the clinical diagnosis difficult. This may contribute in misdiagnosis and thus poor outcomes in these patients. It would be advisable to get electro diagnostic studies pre-operatively to confirm the diagnosis in these patients before undertaking the surgery.

Hypothyroidism

This study did not show significant association between hypothyroidism and the outcome. There are enough studies to support the fact that hypothyroidism is one of the aetiological factors of CTS but there are not enough studies to inform about its association with the surgical outcome. Kececi H and Degirmenci Y showed that hypothyroid patients do well after surgery but they suggested a trial of hormonal replacement therapy before considering surgical release in patients with symptoms of less than the months duration [26]. There is a need of further prospective randomised control study to find out the association of outcome with surgery and the role of hormonal replacement therapy.

Fibromyalgia

The outcomes in patients with fibromyalgia were significantly worse than other patients (p-value=0.001). This was the most important finding in this study. Not much has been mentioned in the literature about the association of fibromyalgia with CTS. Straub TA, showed that the patients with fibromyalgia had significantly poorer results after endoscopic release of CTS [27]. Akkus S et al., showed poor response of CTS patients with fibromyalgia after steroid injections into the carpal tunnel [28].

The main strengths of this study included the community based sample, reasonable number of recruited cases, use of potential predictors across numerous domains including sociodemographic, clinical, and work related factors, and all patients included in the study were being treated in the hand unit at Ninewells hospital under two experienced hand surgeons using same surgical technique and post-operative protocol.

LIMITATION

The limitations of this study included the retrospective nature of the study, possibility of bias such as recall bias in determining the duration of symptoms, virtually all patients being from white population limiting generalisation of the study and not every patient had nerve conduction studies done pre-operatively to confirm the diagnosis.

CONCLUSION

It is strongly believed that the current study will guide, the treating surgeons in predicting the possible outcome of the patients undergoing carpal tunnel release based on their demography and pre-existing health conditions and they will be able to pass this information to their patients pre-operatively, helping them in making a informed decision.

Most interesting finding of this study was the association of fibromyalgia with poor outcome which has never been highlighted before. Further, the patients with fibromyalgia must be warned about possibility of poorer outcomes before going ahead with the surgery.

It is also recommended that patients who require surgery for CTS should be operated irrespective of age, sex, BMI, duration of symptoms, NCS, and diabetes.

This study also highlights the need of a further prospective, randomised study to look into the factors related with poor outcomes in patients undergoing carpal tunnel release.

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