



*British Journal of*  
**Neurosurgery**

*The official journal of the Society of British Neurological surgeons*

*Patrick Mitchell, Editor-in-Chief*





Journal

# British Journal of Neurosurgery >

[About this journal](#)

## Editorial board

### Editor-in-Chief:

[Patrick Mitchell](#) - Newcastle University, Newcastle, UK

### The Neurosurgical Foundation Representatives:

Nigel Mendoza - Chairman of the Neurosurgical Foundation and Treasurer of the Society of British Neurological Surgeons (SBNS)

Alistair Jenkins - President of Society of British Neurological Surgeons (SBNS)

Neil Kitchen - Immediate Past President of Society of British Neurological Surgeons (SBNS)

Michael Jenkinson - Academic Committee Representative

### Associate Editors:

Fardad Afshair - Queen Elizabeth Hospital, Birmingham, UK

Andrew Alalade - Royal Preston Hospital, Preston, UK

Meriem Amarouche - John Radcliffe Hospital, Oxford, UK

Amit Amit - University Hospital Coventry, Coventry, UK

Keyoumars Ashkan - King's College Hospital, London, UK

Chris Barrett - Institute of Neurological Sciences, Glasgow, UK

Pragnesh Bhatt - Aberdeen Royal Infirmary, Aberdeen, UK

Paul Brennan - Western General Hospital, Edinburgh, UK

[Home](#) ▶ [All Journals](#) ▶ [British Journal of Neurosurgery](#) ▶ [Editorial Board](#)

Aswin Chari- Oxford University Hospitals, Oxford, UK

Kishor Choudhari - Royal Hallamshire Hospital, Sheffield, UK

Darach Crimmins - Leeds General Infirmary, Leeds, UK

Andreas Demetriade - Royal Infirmary of Edinburgh, UK

George Eralil - University Hospital of Wales, UK

Gregory James - Great Ormond Street Hospital for Children, UK

Ashwin Kumaria - Nottingham University Hospitals, UK

Paul Leach - University Hospital Wales, UK

Matloob Samir - National Hospital for Neurology Neurosurgery, UK

Millward Christopher - The Walton Center, UK

Mukerji Nitin - James Cook University Hospital, UK

Nair Ramesh - Imperial College Hospital, UK

Narayanamurthy Harsha - Derriford Hospital, UK

Okasha Mohammed - King's College Hospital, UK

Plaha Puneet - Oxford University Hospitals, UK

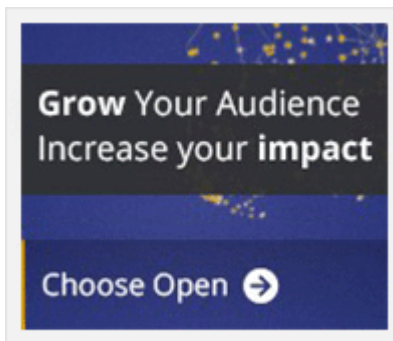
Robertson Iain - Queens Medical Centre, UK

Romani Rossana -

Sinha Priyank - Leeds Teaching Hospital, UK

Tolias Christos - King's College Hospital, UK

Vats Atul - James Cook University Hospital, UK



[Explore](#)[About this journal](#)

# Latest articles

## Original Article

Article

[Pituitary apoplexy: how to define safe boundaries of conservative management? Early and long-term outcomes from a single UK tertiary neurosurgical unit](#) >

Andrea Cavalli, Andrew Martin, Daniel JA Connolly, Showkat Mirza & Saurabh Sinha

Published online: 01 Sep 2020

58

Views

0

CrossRef citations

5

Altmetric

Article



## [Comparison of complications in cranioplasty with various materials: a systematic review and meta-analysis](#) [▶](#)

Qiangjun Wu, Qin Liu, Duoning Chen, Zhufeng Chen, Xuecai Huang, Ming Luo & Shike He

Published online: 01 Sep 2020

49

Views

0

CrossRef citations

0

Altmetric

### Letter to the Editor

Letter

## [Comparison of complications in cranioplasty with various materials: a systematic review and meta-analysis](#) [▶](#)

Ismail Zaed & Benedetta Tinterri

Published online: 31 Aug 2020

32

Views

0

CrossRef citations

0

Altmetric

### Original Article

Article

## [Intra-operative wound irrigation with ceftriaxone does not reduce surgical site infection in clean neurosurgical procedures](#) [▶](#)

Abiodun I. Okunlola, Augustine A. Adeolu, Adefolarin O. Malomo, Cecilia K. Okunlola & Matthew T. Shokunbi

Published online: 31 Aug 2020

[Views](#) | [CrossRef citations](#) |

## Article

### [Efficacy of interspinous device on adjacent segment degeneration after single level posterior lumbar interbody fusion: a minimum 2-year follow-up >](#)

Kwang Ryeol Kim, Chang Kyu Lee & In Soo Kim

Published online: 31 Aug 2020

99	0	0
Views	CrossRef citations	Altmetric

## Short Report

### [Posterior communicating artery infundibulum with oculomotor nerve palsy treated with microvascular decompression: a case report and 2-dimensional technical operative video >](#)

Ehsan Dowlati, Juliana Rotter, Tianzan Zhou, R. Tushar Jha & Rocco A. Armonda

Published online: 28 Aug 2020

22	0	0
Views	CrossRef citations	Altmetric

## Original Article

## [Comparison between outcomes of endovascular and surgical treatments of ruptured anterior communicating artery aneurysms >](#)

Lauren Harris, Ciaran Scott Hill, Matthew Elliot, Teresa Fitzpatrick, Anthony Ghosh & Raghu Vindlacheruvu

Published online: 27 Aug 2020

---

51	0	5
Views	CrossRef citations	Altmetric

---

### Education Report

## [Acute presentation of papillary glioneuronal tumor due to intratumoral hemorrhage in a toddler: an odd presentation of a rare pathology >](#)

Amin Tavallaii, Ehsan Keykhosravi & Hamid Rezaee

Published online: 12 Aug 2020

---

19	0	0
Views	CrossRef citations	Altmetric

---

### Original Article

Article

## [Anatomic variations of the human falx cerebelli and its association with occipital venous sinuses >](#)

Safiye Çavdar, Bilgehan Solmaz, Özgül Taniş, Orhan Ulas Guler, Hakkı Dalçık, Evren Aydoğmuş, Leyla Altunkaya, Erdoğan Kara & Hızır Aslıyüksek

Published online: 12 Aug 2020



[Views](#) | [CrossRef citations](#) | [Altmetric](#)

Article

## [A case of malignant cerebral infarction associated with COVID-19 infection](#) >

Dorina Roy, Milo Hollingworth & Ashwin Kumaria

Published online: 05 Aug 2020

789	0	Altmetric
Views	CrossRef citations	



### Review Article

Review article

## [Manchester Arena Attack: management of paediatric penetrating brain injuries](#) >

Catherine Pringle, Matthew Bailey, Shafqat Bukhari, Ashraf El-Sayed, Stephen Hughes, Vivek Josan, Roberto Ramirez & Ian Kamaly-Asl

Published online: 17 Jul 2020

69	0	Altmetric
Views	CrossRef citations	

### Original Article



## 3.0 Tesla MRI scanner evaluation of supratentorial major white matter tracts and central core anatomical structures of postmortem human brain hemispheres fixed by Klingler method >

Murat Atar, Ceren Kizmazoglu, Ismail Kaya, Nevin Aydin, Ufuk Corumlu, Gulden Sozer, Hasan Emre Aydin, Orhan Kalemci, Nuri Karabay & Nurullah Yuceer

Published online: 16 Jul 2020

---

80	0	Altmetric
Views	CrossRef citations	

---

Article

## Compared with conventional procedures, an intraoperative navigation system for ventriculoperitoneal shunting via the occipital horn improves outcomes in patients with hydrocephalus >

Aijun Peng, Ming Yang, Hai Zhao, YongKang Wu, Yi Zhao & LiangXue Zhou

Published online: 15 Jul 2020

---

52	0	Altmetric
Views	CrossRef citations	

---

Article

## Pediatric brain tumor care in a Sub-Saharan setting: current poise of a precariously loaded dice >

Enoch Ogonnaya Uche, Christopher B. Eke, Okechukwu C. Okafor, Nkechinyere Judith Uche, Obinna V. Ajuzieogu, Dubem S. Amuta, Ephraim E. Onyia, Dung A. Guga, Samuel Okpara, Wilfred C. Mezue, Magnus Tisell & Mats Ryttefors

Published online: 13 Jul 2020

[Views](#) | [CrossRef citations](#) |

## Article

### [Intraventricular administration of antibiotics by ommaya reservoir for patients with multidrug-resistant \*Acinetobacter baumannii\* central nervous system infection >](#)

Yue Chen, Lei Liu & Man Zhu

Published online: 13 Jul 2020

55	0	Altmetric
Views	CrossRef citations	

## Short Report

### [Important aspect of hypoglossal nerve injury following gunshot wound; Can the clivus has a role? A case report >](#)

Bulent Ozdemir, Ayhan Kanat, Cihangir Erturk, Osman Ersegun Batcik, Fatma Beyazal Celiker, Metin Celiker & Engin Dursun

Published online: 11 Jul 2020

39	0	Altmetric
Views	CrossRef citations	

## Original Article

## [Excluding subarachnoid haemorrhage within 24 hours: to LP or not to LP? >](#)

Carolyn Chee, Akmal Mohamad Roji, Nathan Lorde, Hrushikesh Divyateja, Graham Dow, Jagrit Shah & K. Chokkalingam

Published online: 10 Jul 2020

---

227	0	Altmetric
Views	CrossRef citations	

---

### Technical Note

Note

## [Neurosurgical intraoperative ultrasonography using contrast enhanced superb microvascular imaging -vessel density and appearance time of the contrast agent- >](#)

Mami Ishikawa, Kazuto Masamoto, Ryota Hachiya, Hiroshi Kagami, Makoto Inaba, Heiji Naritaka & Shojiro Katoh

Published online: 10 Jul 2020

---

38	0	Altmetric
Views	CrossRef citations	

---

### Research Paper

Article

## [Non-staged bilateral Globus Pallidus Internus deep brain stimulation lead revision using intraoperative MRI: a case report and literature review >](#)



Published online: 10 Jul 2020

---

63	0	Altmetric
Views	CrossRef citations	

---

## Original Article

Article

### [Endovascular treatment for cerebral venous sinus thrombosis – a single center study >](#)

Thomas Hasseris Andersen, Klaus Hansen, Thomas Truelson, Mats Cronqvist, Trine Stavngaard, Marie Elisabeth Cortsen, Markus Holtmannspötter, Joan L Sunnleyg Højgaard, Jakob Stensballe, Karen Lise Welling & Henrik Gutte

Published online: 10 Jul 2020

---

68	0	Altmetric
Views	CrossRef citations	

---

## Review Article

Review article

### [Spinal brucellosis with large circumscribed paraspinal and epidural abscess formation: a case report >](#)

Majid Reza Farrokhi & Seyed Reza Mousavi

Published online: 09 Jul 2020

---

47	0	Altmetric
Views	CrossRef citations	

---

## Original Article

Article

### [Extended lumbar drainage in idiopathic normal pressure hydrocephalus: a systematic review and meta-analysis of diagnostic test accuracy >](#)

Adam C. Nunn, Hayley E. Jones, Cezar O. Morosanu, William G. B. Singleton, Michael A. Williams, Sean J. Nagel, Mark G. Luciano, Thomas J. Zwimpfer, Richard Holubkov, Jeffrey H. Wisoff, Guy M. McKhann II, Mark G. Hamilton & Richard J. Edwards

Published online: 09 Jul 2020

---

165	0	Altmetric
Views	CrossRef citations	

---

Article

### [Increased risk of Ventriculostomy-Associated hemorrhage in patients treated with antiplatelet agents for stent-assisted coiling of ruptured intracranial aneurysms >](#)

Guowen Qin, Gang Pang, Shu Zhong, Haijun Chen, Xihe Tang & Shengyong Lan

Published online: 09 Jul 2020

---

51	0	Altmetric
Views	CrossRef citations	

---

## Short Report

### [Encephalomyelitis associated with Covid-19 infection: case report >](#)

---

129	0	Altmetric
Views	CrossRef citations	

---

## Research Article

Article

[Trans-lateral ventricular approach for surgical treatment of a high located basilar apex aneurysm: report of a rare presentation of the disease and surgical technique >](#)

Alireza Tabibkhouei, Jaber Hatam & Mahisa Mokhtari

Published online: 07 Jul 2020

---

50	0	Altmetric
Views	CrossRef citations	

---

## Original Article

Article

[Bi-needle technique versus transforaminal endoscopic spine system technique for percutaneous endoscopic lumbar discectomy in treating intervertebral disc calcification: a propensity score matched cohort analysis >](#)

Zeng Xu, Jian-Cheng Zheng, Bin Sun, Ke Zhang, Yun-Hao Wang, Chang-Gui Shi, Hui-Qiao Wu, Xiao-Dong Wu, Hua-Jiang Chen & Wen Yuan

Published online: 07 Jul 2020

[Views](#) | [CrossRef citations](#) |

## Letter to the Editor

Letter

### [COVID-19 consequences on medical students interested in neurosurgery: an Italian perspective >](#)

Ismail Zaed

Published online: 06 Jul 2020

---

45	1	Altmetric
Views	CrossRef citations	

---

## Original Article

Article

### [Trigeminal schwannoma: a single-center experience with 43 cases and review of literature >](#)

Mingchu Li, Xu Wang, Ge Chen, Jiantao Liang, Hongchuan Guo, Gang Song & Yuhai Bao

Published online: 06 Jul 2020

---

35	0	Altmetric
Views	CrossRef citations	

---

Article

## [Surgical treatment of neglected C2 odontoid process fracture with anterior atlantoaxial dislocation >](#)

Ming-Wu Li, Xiao-Feng Jiang & Chao-Shi Niu

Published online: 03 Jul 2020

---

43	0	Altmetric
Views	CrossRef citations	

---

Article

## [Surgical treatment of neglected C2 odontoid process fracture with anterior atlantoaxial dislocation >](#)

Vladimir Klimov, Murodzhon Kosimshoev, Aleksey Evsyukov, Vitaly Stepanenko & Jamil Rzaev

Published online: 03 Jul 2020

---

25	0	Altmetric
Views	CrossRef citations	

---

### Letter to the Editor

Letter

## [Aneurysmal subarachnoid hemorrhage in a SARS-CoV-2 positive testing: casual or causal? >](#)

Oriela Rustemi, Fabio Raneri, Giuseppe Iannucci, Lorenzo Volpin & Alessandro Segna

Published online: 02 Jul 2020

---

48	0	Altmetric
Views	CrossRef citations	

---





Article

## [Shunt disconnection is less likely using a surgeon's knot compared with a surgical constrictor knot >](#)

Mohamed Okasha, Gareth M. Dobson, Ioannis Tsonis, Mohammed Hussain & Nicholas Ross

Published online: 01 Jul 2020

81

Views

0

CrossRef citations

3

Altmetric

Article

## [Relationship between disability and pain to post-traumatic stress disorder, depression, and anxiety in patient with postoperative brachial plexus injury \(BPI\) >](#)

Heri Suroto, Ramadhan Ananditia Putra & Azimatul Karimah

Published online: 30 Jun 2020

53

Views

0

CrossRef citations

3

Altmetric

### Letter to the Editor

Letter

## [Indirect effects of the COVID19 pandemic in patients requiring neurosurgical care: will the second wave carry more severe neurosurgical patients? >](#)

Published online: 30 Jun 2020

---

37	0	Altmetric
Views	CrossRef citations	

---

## Original Article

Article

### [Management of spontaneous intracranial hypotension: a series of 31 cases over 15-years with a challenging outlier >](#)

Mark McCann, Keith Kelly, Drahoslav Sokol & Mark A. Hughes

Published online: 26 Jun 2020

---

64	0	Altmetric
Views	CrossRef citations	

---

## Technical Note

Note

### [Application of intra-operative magnetic resonance imaging for intracranial epidermoid cysts >](#)

Akihide Kondo, Osamu Akiyama, Shigeki Aoki & Hajime Arai

Published online: 26 Jun 2020

---

23	0	Altmetric
Views	CrossRef citations	

---



Article

## [A comparison of frailty indices in predicting length of inpatient stay and discharge destination following angiogram-negative subarachnoid hemorrhage >](#)

Matthew K. McIntyre, Chirag Gandhi, James Dragonette, Meic Schmidt, Chad Cole, Justin Santarelli, Rachel Lehrer, Fawaz Al-Mufti & Christian A. Bowers

Published online: 25 Jun 2020

---

46	0	0
Views	CrossRef citations	Altmetric

---

Article

## [Reciprocal relationship between multifidus and psoas at L4-L5 level in women with low back pain >](#)

Emel Ece Özcan-Ekşi, Murat Şakir Ekşi, Veli Umut Turgut, Çağrı Canbolat & M. Necmettin Pamir

Published online: 24 Jun 2020

---

57	1	0
Views	CrossRef citations	Altmetric

---

Article

## [Treatment strategies of ruptured intracranial aneurysms associated with moyamoya disease >](#)

Xu Zhao, Xiaofei Wang, Mingqing Wang, Qinghu Meng & Chengwei Wang

Published online: 22 Jun 2020

[Views](#) | [CrossRef citations](#) |

Article

## [Arachnoid prolapse in endoscopic transsphenoidal surgery of pituitary adenoma, technical note](#) >

Guive Sharifi, Nader Akbari Dilmaghani, Seyed Mousa Sadrhosseini &amp; Shima Arastou

Published online: 22 Jun 2020

48	0	Altmetric
Views	CrossRef citations	

### Review Article

Review article

## [Adenosine-induced transient asystole to control intraoperative rupture of intracranial aneurysms: institutional experience and systematic review of the literature](#) >

Eric S. Nussbaum, Elizabeth Burke &amp; Leslie A. Nussbaum

Published online: 19 Jun 2020

28	0	Altmetric
Views	CrossRef citations	

Review article



## [Updates, and concept of stability](#) >

Hanuman Prasad Prajapati & Raj Kumar

Published online: 19 Jun 2020

40

Views

0

CrossRef citations

Altmetric

## Original Article

Article

## [Trans-thoracic versus retropleural approach for symptomatic thoracic disc herniations: comparative analysis of 94 consecutive cases](#) >

Christian Soda, Franco Faccioli, Nicolò Marchesini, Umberto M. Ricci, Marco Brollo, Luciano Annicchiario, Cristiano Benato, Ivan Tomasi, Giampietro P. Pinna & Marco Teli

Published online: 19 Jun 2020

57

Views

0

CrossRef citations

Altmetric

Article

## [Impact of COVID-19 pandemic on acute spine surgery referrals to UK tertiary spinal unit: any lessons to be learnt?](#) >

Sashin Ahuja, Pranav Shah & Riaz Mohammed

Published online: 17 Jun 2020

[Views](#) | [CrossRef citations](#) |

## Technical Note

Note

### [Surgical technique modification of circumferential decompression for thoracic spinal stenosis and clinical outcome](#) >

Ruofu Tang, Jiawei Shu, Hao Li & Fangcai Li

Published online: 17 Jun 2020

59

Views

0

CrossRef citations

Altmetric

Note

### [Temporo-parietal muscle pedicle flap for reconstruction of the anterior skull base after resection of recurrent olfactory groove meningioma: a technical note](#) >

Toshikazu Kimura, Tomoyuki Yano & Atsuya Akabane

Published online: 17 Jun 2020

51

Views

0

CrossRef citations

Altmetric

## Original Article

## [Surgical outcomes in patients with endoscopic versus transcranial approach for skull base malignancies: a 10-year institutional experience >](#)

John W. Rutland, Corey M. Gill, Travis Ladner, David Goldrich, Dillan F. Villavisanis, Alex Devarajan, Akila Pai, Amir Banihashemi, Brett A. Miles, Sonam Sharma, Priti Balchandani, Joshua B. Bederson, Alfred M. Iloreta & Raj K. Shrivastava

Published online: 15 Jun 2020

95

Views

0

CrossRef citations

Altmetric

### Short Report

Report

## [Intravenous sinus meningioma with intraluminal extension to the internal jugular vein: case report and review of the literature >](#)

Kei Yamashiro, Mitsuhiro Hasegawa, Saeko Higashiguchi, Hisayuki Kato & Yuichi Hirose

Published online: 15 Jun 2020

56

Views

2

CrossRef citations

Altmetric

### Original Article

Article

## [Optimal target localisation and eight-year outcome for subthalamic stimulation in patients with Parkinson's disease >](#)

Song Guo, Jianyu Li, Yuqing Zhang, Yongjie Li & Ping Zhuang

📄	U	Altmetric
Views	CrossRef citations	

### Short Report

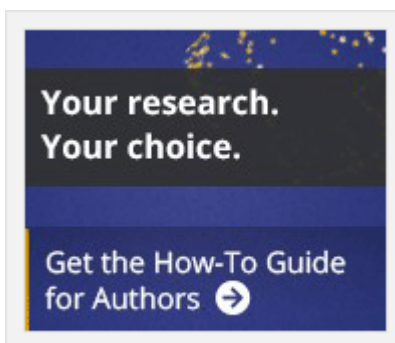
## Spinal segmental myoclonus following spinal surgery >

Shrikant Pande, Kokcher Ang, May Win Myat, Shermyn Neo & Sivashankar Subramaniam

Published online: 12 Jun 2020

35	0	Altmetric
Views	CrossRef citations	

< 1 ... 3 4 5 6 7 ... 10 >







▼  
Authors

Editors

Librarians

Societies

Help and info

Help & contact

Newsroom

Commercial services

Advertising information

All journals

Books

Overview

Open journals

Open Select

Cogent OA

Dove Medical Press

F1000Research

Keep up to date

Register to receive personalised research and resources by email

 Sign me up



# Relationship between disability and pain to post-traumatic stress disorder, depression, and anxiety in patient with postoperative brachial plexus injury (BPI)

Heri Suroto<sup>a</sup>, Ramadhan Ananditia Putra<sup>a</sup> and Azimatul Karimah<sup>b</sup>

<sup>a</sup>Departement of Orthopaedic and Traumatology, Faculty of Medicine, Dr. Soetomo General Academic Hospital, Universitas Airlangga, Surabaya, Indonesia; <sup>b</sup>Departement of Psychiatry, Faculty of Medicine, Dr. Soetomo General Academic Hospital, Universitas Airlangga, Surabaya, Indonesia

## ABSTRACT

**Background:** Orthopedic trauma patients have the risk to experience mental disorders, including depression, anxiety, post-traumatic stress disorder (PTSD), and other mental disorders. However, studies that analyze the relationship between mental disorders in orthopedic trauma patients, especially post-operative brachial plexus injury (BPI), are still difficult to find. This study aims to evaluate the relationship between disability and pain to post-traumatic stress disorder, depression, and anxiety in patient with postoperative BPI.

**Materials and methods:** It was an observational analysis with cross-sectional design study. Data were collected from July 2019 to September 2019. All subjects were patients of Orthopedics Clinic Dr. Soetomo General Academic Hospital Surabaya. The Disabilities of the Arm, Shoulder, and Hand (DASH) score was used to determine the disability level in patients. Visual Analog Score (VAS) was an instrument for assessing pain scale and mental disorders used Mini International Psychiatry Interview (MINI).

**Results:** There were 41 subjects met the research criteria, consisted of 10 men (24.39%) and 31 women (75.61%), aged 12–63 years. Based on the status of education, most subjects were graduated from junior/senior high school with 28 subjects (68.29%). The most common cause of BPI was traffic accidents as many as 37 people (90.24%). Mental disorders diagnosed from MINI found ten people (24.39%) were diagnosed with major depression; two subjects (4.87%) had generalized anxiety disorder. The average VAS score was 5.15 and the average DASH score was 52.02. There was no significant difference in VAS scores in the major depression group and PTSD group. However, there was an association between DASH score and depression ( $p < 0.05$ ). Surprisingly, this study found the risk of suicide among BPI (7.3%) and one person with psychotic disorders (2.43%).

**Conclusion:** The level of disability and pain in orthopedic trauma patients with depression tend to more severe than without depression.

## ARTICLE HISTORY

Received 23 February 2020

Revised 9 June 2020

Accepted 16 June 2020

## KEYWORDS

BPI; mental disorders; disability; pain

## Introduction

Loss of upper limb function after brachial plexus injury (BPI) causes a sensory and motor deficit that requires complex microsurgical reconstruction.<sup>1,2</sup> BPI in adults can be caused by a variety of mechanisms, including puncture injuries, falls, and motor vehicle accidents.<sup>3–5</sup> The incidence of post-traumatic stress disorder (PTSD), depression, and psychological distress are quite high after orthopedic trauma. Some studies show that one-third of patients who experience orthopedic trauma experience mental disorders and signs of mood disorders.<sup>1,6,7</sup> Likewise, upper limb nerve injury affects daily functioning, causing a decrease in perceived quality of life. Various studies that assess quality of life, functional outcomes, and patient satisfaction after brachial plexus injury (BPI) surgery conclude that patients are adversely affected in terms of financial status, employment status, independence in carrying out daily life activities, body image, functional outcomes, subjective health, and overall satisfaction despite improvements in motor results.<sup>8–10</sup>

Although the psychological impact of upper limb peripheral nerve injury has been investigated, the psychosocial and psychological effects of traumatic BPI on adults have not been adequately treated.<sup>6–9,11</sup> Some studies note that complete traumatic avulsion BPI interferes with body image perception, causes difficulty accepting and adapting to BPI, and is associated with a higher incidence of depression.<sup>12,13</sup> However, studies that analyze the relationship between mental disorders in orthopedic trauma patients, especially post-operative BPI are still difficult to find. Knowing that severe upper limb injuries increase the risk of psychological distress and to improve BPI's multidisciplinary treatment, we aim to evaluate the relationship between disability and pain on post-traumatic stress disorder, depression, and anxiety in postoperative BPI.

## Materials and methods

This study was a cross-sectional study design with descriptive-analytic. The study was conducted at the Orthopedics Hospital, Dr. Soetomo, and home visits with the patient's permission.

Table 1. Demographic subjects.

Characteristic	Depression (%)	Anxiety (%)	PTSD (%)	DASH	VAS
<b>Age</b>					
Adolescent (12–25 yo)	4 (40)	0 (0)	0 (0)	50.0553	4.133
Adult (26–45 yo)	5 (50)	2 (100)	2 (100)	46.8355	4.55
Elderly (46–65 yo)	1 (10)	0 (0)	0 (0)	38.9017	2.833
<b>Sex</b>					
Male	7(70)	0 (0)	0 (0)	43.93	4.32
Female	3(30)	2 (100)	2 (100)	55.93	3.6
<b>Educational Background</b>					
Elementary School/Not Finished	4 (40)	2 (100)	2 (100)	63.18	4.2
Junior High School/Senior High School	5 (50)	0 (0)	0 (0)	42.37	4.29
University	1 (10)	0 (0)	0 (0)	52.33	3.63
<b>Occupation</b>					
Housewife	0 (0)	0 (0)	0 (0)	–	–
Student	1 (10)	0 (0)	0 (0)	68.83	3.4
Government Employees	0 (0)	0 (0)	0 (0)	47.5	2.5
Private Employees	2 (20)	1 (50)	1 (50)	43.1	4.77
Informal Workers	3 (30)	1 (50)	1 (50)	24.51	3.67
Entrepreneur	2 (20)	0 (0)	0 (0)	38.82	3.57
Not employer	2 (20)	0 (0)	0 (0)	60.12	4.71
<b>Interval between injury to surgery</b>					
0–6 Months	2 (20)	0 (0)	0 (0)	37.69	4
6–12 Months	4 (40)	1 (50)	1 (50)	55.72	3.43
12–24 Months	1 (10)	0 (0)	0 (0)	64.38	5.13
>24 Months	3 (30)	1 (50)	1 (50)	66.68	4.11
<b>Interval between surgery to follow-up</b>					
0–6 months	3 (30)	1 (50)	1 (50)	57.00	4.40
6–12 months	0 (0)	0 (0)	0 (0)	17.5	5
12–24 months	2 (20)	0 (0)	0 (0)	50.33	3.6
>24 months	5 (50)	1 (50)	1 (50)	45.55	4.17
<b>Affected side</b>					
Left	2 (20)	0 (0)	0 (0)	47.98	4.57
Right	8 (80)	2 (100)	2 (100)	44.62	3.89
<b>Affected hand</b>					
Dominant	8 (80)	2 (100)	2 (100)	47.66	3.91
Non-Dominant	2 (20)	0 (0)	0 (0)	45.41	4.65
Bilateral	0 (0)	0 (0)	0 (0)	52.5	1.00
<b>Marital Status</b>					
Married	6 (60)	1 (50)	1 (50)	39.06	4.28
Not Married	4 (40)	1 (50)	1 (50)	52.95	4.04
<b>Smoking Habit</b>					
Yes	7 (70)	1 (50)	1 (50)	46.88	5
No	3 (30)	1 (50)	1 (50)	46.84	3.79

### Patient selection

The subject was BPI patients who control at the Orthopedic and Traumatology Polyclinic of RSUD Dr. Soetomo Surabaya and the Indonesian BPI Community with Traumatic BPI that meet the research requirements. Approval was obtained from our institutional review board and the medical ethics committee before study initiation and the study protocol followed the principles of the Declaration of Helsinki.

### Inclusion criteria

Inclusion criteria were as follows: (1) BPI traumatic patients who have had nerve or muscle reconstruction surgery; (2) Patients do not have abnormalities/other diseases that affect nerve and muscle function.

### Exclusion criteria

Exclusion criteria were: (1) Patients with nerve or muscle disorders without a history of previous trauma; (2) Patients diagnosed with previous mental disorders; (3) Patients who do not approve Informed Consent.

### Procedural details

The Disabilities of the Arm, Shoulder, and Hand (DASH) and Visual Analog Score (VAS) were used to determine the level of disability in patients and assessing pain scale, respectively. Meanwhile, Mini International Psychiatry Interview (MINI) was used to assessing mental disorders. The interval time between injury and surgery performed and interval time between surgery to follow up were divide into: 0–6 months, 6–12 months, 12–24 months and >24 months. Meanwhile the affected hand was divide into: dominant hand; non-dominant hand and bilateral.

### Statistical analysis

The demographic data were described and tabulated. The bivariate analysis was done using the Mann–Whitney test, Kruskal–Wallis Test and Chi-Square test. A logistic regression test was done to assessed multivariate analysis in the study. Data analysis is performed using SPSS software version 25.0.

### Results

This study obtained 41 subjects. Thirty-seven people suffered BPI injuries due to traffic accidents (90.2%), three people due to

**Table 2.** Analysis of different characteristics of demographics data with DASH, VAS, depression, anxiety, and post-traumatic stress disorder (PTSD).

Variable	N	DASH (Mean Rank)	Siq	VAS (Mean Rank)	Siq	Depression (%)	Siq <sup>c</sup>	Anxiety (%)	Siq <sup>c</sup>	PTSD (%)	Siq <sup>c</sup>
<b>Age<sup>a</sup></b>											
Adolescent (12–25 yo)	15	21.97	0.85	21.27	0.23	4 (40)	0.887	0 (0)	0.332	0 (0)	0.332
Adult (26–45 yo)	20	20.95		23		5 (50)		2 (100)		2 (100)	
Elderly (46–65 yo)	6	18.75		13.67		1 (10)		0 (0)		0 (0)	
<b>Sex<sup>b</sup></b>											
Male	10	24.7	0.26	18.3	0.40	7(70)	0.683	0 (0)	1	0 (0)	1
Female	31	19.81		21.84		3(30)		2 (100)		2 (100)	
<b>Educational Background<sup>a</sup></b>											
Elementary School/Not Finished	5	28.6	0.22	21.6	0.53	4 (40)	0.008	2 (100)	0.001	2 (100)	0.001
Junior High School/Senior High School	28	19.09		22.01		5 (50)		0 (0)		0 (0)	
University	8	23.15		16.85		1 (10)		0 (0)		0 (0)	
<b>Occupation<sup>a</sup></b>											
Housewife	1	37	0.11	33.5	0.49	0 (0)	0.696	0 (0)	0.79	0 (0)	0.79
Student	5	29.7		16.8		1 (10)		0 (0)		0 (0)	
Government Employees	2	22.25		11.5		0 (0)		0 (0)		0 (0)	
Private Employees	13	19.57		24.34		2 (20)		1 (50)		1 (50)	
Informal Workers	6	12.58		18.08		3 (30)		1 (50)		1 (50)	
Entrepreneur	7	16.35		18.07		2 (20)		0 (0)		0 (0)	
Not employer	7	26.64		24.14		2 (20)		0 (0)		0 (0)	
<b>Interval between injury to surgery<sup>a</sup></b>											
0–6 Months	17	16.97	0.14	19.97	0.44	2 (20)	0.088	0 (0)	0.338	0 (0)	0.338
6–12 Months	7	25.14		16.92		4 (40)		1 (50)		1 (50)	
12–24 Months	8	27.68		26.5		1 (10)		0 (0)		0 (0)	
>24 Months	9	19.44		21.22		3 (30)		1 (50)		1 (50)	
<b>Interval between surgery to follow-up</b>											
0–6 months	5	25.40	0.65	22.60	0.87	3 (30)	0.145	1 (50)	0.403	1 (50)	0.403
6–12 months	1	20.00		26.50		0 (0)		0 (0)		0 (0)	
12–24 months	5	22.10		17.80		2 (20)		0 (0)		0 (0)	
>24 months	30	20.45		21.08		5 (50)		1 (50)		1 (50)	
<b>Affected side<sup>a</sup></b>											
Left	14	21.25	0.24	23.57	0.50	2 (20)	0.434	0 (0)	0.545	0 (0)	0.545
Right	26	20.11		19.40		8 (80)		2 (100)		2 (100)	
Left and Right	1	40.5		26.5		0 (0)		0 (0)		0 (0)	
<b>Affected hand</b>											
Dominant	23	21.78	0.86	19.50	0.13	8 (80)	0.208	2 (100)	0.439	2 (100)	0.439
Non-Dominant	17	19.82		24.12		2 (20)		0 (0)		0 (0)	
Bilateral	1	23.00		2.5		0 (0)		0 (0)		0 (0)	
<b>Marital status<sup>b</sup></b>											
Married	18	18.11	0.17	21.44	0.83	6 (60)	1	1 (50)	1	1 (50)	1
Not Married	23	23.26		20.65		4 (40)		1 (50)		1 (50)	
<b>Smoking habit<sup>b</sup></b>											
Yes	12	21.5	0.86	25.33	0.13	7 (70)	1	1 (50)	0.505	1 (50)	0.505
No	29	20.79		19.20		3 (30)		1 (50)		1 (50)	

<sup>a</sup>Tested with Kruskal–Wallis.<sup>b</sup>Tested with Mann–Whitney *U*.<sup>c</sup>Tested with Chi-square.

work accidents (7.3%) and one person due to glass puncture injuries (2.5%). Ten people were diagnosed with depression (24.4%), two people with anxiety (4.87%) and two people with post-traumatic stress disorder (PTSD) (4.87%) as the studied variables. But this study also found another mental disorder that is three people diagnosed with suicide risk (7.3%) and one person with psychotic disorders (2.43%). All respondents in the study still complained of pain with different degrees. Eighteen people (43.9%) complained of mild pain with VAS values 1–3. Seventeen people (41.5%) complained of moderate pain with a VAS value of 4–6, and 6 people (14.6%) had severe pain with a VAS value above 6. The VAS score in the depression group was 3.7, while in the anxiety group and the PTSD, it had the same VAS score average of 3.5. The average VAS score was 5.15 and the average DASH score was 52.02. The average value of the DASH score in the depression group was 58.42; the anxiety group was 55, and the PTSD group was 55. The distribution of each demographic from the primary data can be seen in Table 1.

Table 2 showed there is no significant difference in DASH and VAS scores between all variables. Meanwhile, there was a significant difference in education background in anxiety, depression, and PTSD groups ( $p < 0.05$ ). Table 3 showed there is a

**Table 3.** DASH and VAS Score differentiation test with depression, anxiety, and PTSD.

Variable	N	Depression (Siq)	Anxiety (Siq)	PTSD (Siq)
<b>DASH</b>				
Mild	12	0.017	0.474	0.474
Moderate	14			
Severe	15			
<b>VAS</b>				
Mild	18	0.849	0.722	0.722
Moderate	17			
Severe	6			

significant difference in the DASH score in the depression group and there is no significant difference in VAS score in all groups.

Table 4 showed the results of data processing by logistic regression of all study variables associated with depression, which showed no significant were obtained. Table 5 showed the results of the logistic regression data for all study variables related to VAS and DASH scores. It was found that a significant relationship ( $p < 0.05$ ) between educational status and marital status with the DASH score.

**Table 4.** Results of logistic regression analysis for depression.

Variable	B	df	Sig.
Sex		2	0.99
Male	-68.86775835	1	0.99
Female	29.6365101	1	0.99
Education	-100.0758593	1	0.99
Work		6	1
Housewife	230.1037446	1	0.99
Student	429.0919604	1	0.99
Government employees	361.8865815	1	0.99
Private employees	318.5269699	1	0.99
Informal workers	445.7841526	1	0.99
Entrepreneur	299.6561692	1	0.99
Marital status	60.65414189	1	0.99
History of smoking	3.211058509	1	0.99
Interval between injury to surgery		3	0.99
0-6 Months	65.91094635	1	0.99
6-12 Months	-43.00083298	1	0.99
12-24 Months	30.20819312	1	0.99
Interval between surgery to follow-up		3	0.99
0-6 months	2.015432424	1	0.99
6-12 months	-19.593523465427	1	0.99
12-24 months	1.20434124654	1	0.99
>24 months	-1.60974879	1	0.99
Side Affected		2	0.99
Left	67.02905731	1	0.99
Right	74.86479521	1	0.99
Affected hand	-1.426978494	1	0.99
VAS		2	0.99
Mild	34.30524127	1	0.99
Moderate	119.6592909	1	0.99
DASH		2	0.99
Mild	63.8700137	1	0.99
Moderate	177.0575865	1	0.99
Constant	-355.7205189	1	0.99

**Table 5.** Logistic regression results for VAS and DASH score.

Variable	N	Chi-Square	df	Sig.
Sex				
Male	10	4.079273902	2	0.13 <sup>a</sup>
Female	31			
Age				
Adolescent (12-25 yo)	15	1.05651221	4	0.90
Adult (26-45 yo)	20			
Elderly (46-65 yo)	6			
Education background				
Elementary	5	10.80047182	4	0.02 <sup>a</sup>
Junior-senior Highschool	28			
University	8			
Marital Status				
Not married	23	7.70587146	2	0.02 <sup>a</sup>
Married	18			
History of smoking				
No	29	3.088566917	2	0.21
Yes	12			
Affected side				
Left	14	9.099052434	4	0.05 <sup>a</sup>
Right	26			
Left and Right	1			
Affected hand				
Dominant	23	8.73900286	3	0.71
Non-Dominant	17			
Bilateral	1			
Work				
Formal	20	1.376356938	2	0.50
Informal	21			
Interval between injury to surgery				
<6 months	17	3.449203994	2	0.17
>6 Months	24			
Interval between surgery to follow up				
0-24 months	11	4.753438484	4	0.63
>24 months	30			

<sup>a</sup>Model Fitting Sig. 0.176.

## Discussion

Depression, anxiety, and post-traumatic stress disorder affect the functional outcomes of BPI patients who have undergone surgery.<sup>12</sup> This is a factor that must be considered because BPI patients who have undergone surgery must go through a long rehabilitation phase to obtain maximum results. Many studies have evaluated the effect of mental disorders after injury, but few have assessed the psychological aspects after reconstructive surgery in BPI traumatic patients.<sup>12,14,15</sup>

These study results were not much different from Wilson and Chang's study which said 27% of patients with traumatic brachial plexus injury suffer from postoperative depression. As for anxiety and post-traumatic stress disorder, there are only two sufferers each.<sup>16</sup> Educational status gave significant results ( $p < 0.05$ ) on depression, anxiety, and PTSD. This shows the relationship between education level and mental disorder. In this study, mental disorders were found mostly in the category of elementary school education/not graduating as many as eight people, followed by five people middle school/high school, and one person university. The data shows that a higher level of education affects mental disorders. This is consistent with research from Bjelland *et al.* Which states that the higher the level of education becomes a means of protection against depression and anxiety.<sup>17</sup>

Based on the data in this study, the higher the DASH score, is directly proportional to the number of patients diagnosed with depression. But it still cannot be concluded whether the level of disability that causes depression or depression that causes increased disability levels. Impairment in BPI patients themselves is influenced by many factors both during preoperative such as nerve level injury; therapy is given, timing surgery, patient age to post-operative rehabilitation.<sup>3,11,18</sup> In this study, there is a significant relationship ( $p < 0.05$ ) between educational status and marital status with a DASH score. However, according to a study conducted by Wilson *et al.* that depression and anxiety reduce motor outcome after surgery in BPI patients.<sup>16</sup>

This study showed different results from the research of Rasulic *et al.*, which mentions that 76.8 percent of research respondents still complain of pain with varying degrees.<sup>18</sup> Many factors influence the onset of chronic pain in BPI aside from the pathology of the disease itself, such as smoking history, marital status, status education, and mental disorders.<sup>19</sup> But in this study still not found statistically significant figures.

A study by Lander *et al.* in 10 of the 46 patients interviewed after being diagnosed with BPI, they had suicidal ideation.<sup>6</sup> Although the figures obtained are smaller than the study, the risk of suicide in BPI patients needs to be considered in BPI management. This study also found one person diagnosed with a psychotic disorder. Patients complain of symptoms that lead to psychosis disorders felt after the occurrence of injury. However, this matter still needs to be investigated further due to the multifactorial risk of psychosis.<sup>12,20</sup>

As the end of the discussion of this study obtained some notes of research limitations this research method uses a cross-sectional design so that it is difficult to determine the direction of the causal relationship between exposure and the dynamic process. The nature of the study sample is a compelling medical population, so the relationship between the variables studied can be designed by factors that interact in the ability to react to disease, but factors that are confounding variables already existed before this study began. This study uses a questionnaire that relies on the subject's memory, so there is a recall bias toward symptoms or disorders experienced by patients. The research sample in this patient is a patient who has undergone surgery.

Many factors affect the outcome or outcome of operation both in preoperative, intra, and post-operative. Also, the heterogeneity of the level of injury and intervention in BPI management makes the analysis of this study limited. Minimal population samples in this study.

## Conclusions

The level of disability in postoperative BPI patients is related to educational status, marital status, and the presence of depression. The level of education is associated with the presence of generalized anxiety disorder and post-traumatic stress disorder in post-operative BPI patients. There was a significant relationship between educational status and marital status with the DASH score. Meanwhile, there no significant relation between VAS and other variables. The results of this study suggest that psychological aspects need to be considered by clinicians in the management of postoperative BPI patients. Depression on orthopedic trauma patients leads to disabling more and more pain levels than without depression.

## Disclosure statement

No potential conflict of interest was reported by the author(s).

## References

- Estrella EP. Functional outcome of nerve transfers for upper-type brachial plexus injuries. *J Plast Reconstr Aesthetic Surg* 2011;64:1007–13.
- Han CS, Chung DW, Shin DJ, Im YS. Neurotization of brachial plexus injury. *J Korean Orthop Assoc* 2003;38:503–9.
- Park HR, Lee GS, Kim IS, Chang J-C. Brachial plexus injury in adults. *Nerve* 2017;3:1–11.
- Tu YK, Tsai YJ, Chang CH, Su FC, Hsiao CK, Tan J. Surgical treatment for total root avulsion type brachial plexus injuries by neurotization: a prospective comparison study between total and hemicontralateral C7 nerve root transfer. *Microsurgery* 2014;34:91–101.
- Hale HB, Bae DS, Waters PM. Current concepts in the management of brachial plexus birth palsy. *Journal of Hand Surgery* 2010; 35(2): 322–31.
- Landers ZA, Jethanandani R, Lee SK, Mancuso CA, Seehaus M, Wolfe SW. The psychological impact of adult traumatic brachial plexus injury. *J Hand Surg Am* 2018;43:950.e1–e6.
- Michaels AJ, Michaels CE, Smith JS, Moon CH, Peterson C, Long WB. Outcome from injury: general health, work status, and satisfaction 12 months after trauma. *J Trauma* 2000;48:841–8.
- Dolan RT, Butler JS, Murphy SM, Hynes D, Cronin KJ. Health-related quality of life and functional outcomes following nerve transfers for traumatic upper brachial plexus injuries. *J Hand Surg Eur Vol* 2012;37: 642–51.
- Novak CB, Anastakis DJ, Beaton DE, Katz J. Patient-reported outcome after peripheral nerve injury. *J Hand Surg Am* 2009;34:281–7.
- Kaiser R, Mencl L, Haninec P. Injuries associated with serious brachial plexus involvement in polytrauma among patients requiring surgical repair. *Injury* 2014;45:223–6.
- Kitajima I, Doi K, Hattori Y, Takka S, Estrella E. Evaluation of quality of life in brachial plexus injury patients after reconstructive surgery. *Hand Surg* 2006;11:103–7.
- Franzblau L, Chung KC. Psychosocial outcomes and coping after complete avulsion traumatic brachial plexus injury. *Disabil Rehabil* 2015;37: 135–43.
- Gustafsson M, Amilon A, Ahlström G. Trauma-related distress and mood disorders in the early stage of an acute traumatic hand injury. *J Hand Surg Am* 2003;28: 332–8.
- Bailey R, Kaskutas V, Fox I, Baum CM, Mackinnon SE. Effect of upper extremity nerve damage on activity participation, pain, depression, and quality of life. *J Hand Surg Am* 2009;34:1682–8.
- Kanaya F, Gonzalez M, Park CM, Kutz JE, Kleinert HE, Tsai TM. Improvement in motor function after brachial plexus surgery. *J Hand Surg Am* 1990;15:30–6.
- Wilson T, Chang K, Yang L. Depression and anxiety in traumatic brachial plexus injury patients are associated with reduced motor outcome after surgical intervention for restoration of elbow flexion. *Clin Neurosurg* 2016;78:850.
- Bjelland I, Krokstad S, Mykletun A, Dahl AA, Tell GS, Tambs K. Does a higher educational level protect against anxiety and depression? The HUNT study. *Soc Sci Med* 2008;66:1334–45.
- Rasulić L, Savić A, Živković B, et al. Outcome after brachial plexus injury surgery and impact on quality of life. *Acta Neurochir (Wien)* 2017;159:1257–64.
- Saiz-Sapena N, Vanaclocha V, Ortiz Criado J, Vanaclocha L, Vanaclocha N, 2019. Treatment of neuropathic pain in brachial plexus injuries. In: Vicente Vanaclocha (pp. 103–110). *Treatment of brachial plexus injuries*. UK: Intech Open.
- Gustafsson M, Ahlström G. Emotional distress and coping in the early stage of recovery following acute traumatic hand injury: a questionnaire survey. *Int J Nurs Stud* 2006;43:557–65.