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A Systematic Review of Outcomes Reporting for Brachial Plexus Reconstruction

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Abstract

Purpose: To better understand the manner in which outcomes are reported after brachial plexus reconstruction, we conducted a systematic review of the scientific literature.

Methods: We included English-language articles describing treatment of brachial plexus injuries to restore motor function of the shoulder, elbow, forearm, and/or wrist with nerve repair, nerve graft, and/or nerve transfer. We recorded the anatomic location of injury, the treatment used, and the manner in which motor function, active and passive range of motion, pain, quality of life, function or disability, patient satisfaction, and psychosocial health were reported.

Results: In reviewing 88 papers with outcomes for 5,189 patients, 83 (94%) of the papers reported postoperative motor function. Of these, 49 (59%) did not include any other measures of patient outcome. Active range of motion was reported in 24 (27%) studies, pain was reported in 15 (17%) studies, quality of life was reported in 4 (5%) studies, function or disability was reported in 5 (6%) studies, patient satisfaction in 3 (3%) studies, and psychosocial health was reported in 1 study.

Discussion: To date, outcome reporting for brachial plexus surgery has largely centered on motor recovery and typically has not included measures of function or non-musculoskeletal recovery. Incorporating currently-used measures of physical recovery with patient-derived outcomes measures such as quality of life, function, pain, and satisfaction will likely help provide a more comprehensive understanding of the effect of brachial plexus reconstruction surgery.

Level of Evidence: Diagnostic Level III (Systematic Review of Diagnostic Level III studies)

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INTRODUCTION

Surgeons, patients, and society invest a considerable amount of resources in the treatment of brachial plexus injuries (BPI). Despite this investment, the various postsurgical outcomes for BPI patients remain difficult to precisely predict as each BPI pattern and treatment is unique [1,2]. As surgical techniques and treatment strategies for brachial plexus injuries have advanced rapidly, there has been a contemporaneous increase in the emphasis on patient-reported measures in clinical research [3]. As improvement after surgery cannot be adequately evaluated using only clinician grading of muscle strength, a more all-encompassing perspective is necessary to reflect a patient's functional recovery.

While the need to enhance the reporting of outcomes after brachial plexus surgery has been previously articulated [4–6], the urgency to accomplish this task is growing. As competition for health care resources continues to grow, clinicians and researchers must demonstrate that brachial plexus surgery can deliver reliable and valuable outcomes [7]. To inform these ongoing efforts, we performed a systematic review of the literature with the aim of better understanding the manner in which outcomes after brachial plexus nerve reconstructive surgery are currently reported. We hypothesized that existing literature was focused largely on clinician grading of muscle function with minimal emphasis on patient-centered outcomes.

METHODS

Literature Search

We performed a search of the English-language literature using the PubMed/MEDLINE (search conducted on July 15, 2013), EMBASE (search conducted on August 25, 2013), and Cochrane Central Register of Controlled Trials (search conducted on August 25, 2013) databases (all years considered up to the date of the searches). We searched these databases using the following keywords: “brachial plexus” or “brachial plexus neuropathies” AND “surgery” or “surgical treatment” or “reconstruction” AND “outcomes” or “assessments”. The searches were conducted by a medical librarian, who expanded each of these keywords into corresponding Medical Subject Heading terms. Following elimination of duplicate search results, this produced 1,499 articles. The titles and abstracts were separately reviewed by 2 investigators to exclude articles unrelated to our topic. Full-length papers were then read separately by the same 2 investigators to ensure that the article met the inclusion and exclusion criteria for our study. We then performed a manual reference check of all remaining articles to identify any additional studies for inclusion. Formal review of the papers was conducted autonomously by the same 2 reviewers using a data extraction form that was designed prior to the literature search. Any disagreement between the 2 reviewers during this process was resolved through discussion under the guidance of the senior author. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses [8,9] guidelines were adhered to in the reporting of our systematic review.

Inclusion and Exclusion Criteria

We included articles that met all of these criteria: English-language full text; treatment of brachial plexus injuries to restore motor function of the shoulder, elbow, forearm, and/or wrist; and treatment with nerve repair, nerve graft, and/or nerve transfer. During review of titles and abstracts, we excluded articles that described cadaveric or non-human studies; regional anesthesia of the brachial plexus; peripheral nerve injuries (distal to the axilla); literature reviews, technique descriptions, expert opinion; and obstetric or neonatal brachial plexus injuries (Figure 1). During review of full-length papers, we excluded articles that described only reconstruction for oncologic cases, those that described nerve surgery to treat sensory deficits after BPI, and those in which data presentation was insufficient for extraction. Articles that described only reconstructive muscle transfer, tendon transfer, and arthrodesis were excluded from the study to optimize the homogeneity of the cohort, as evaluation of the use of clinician grading of muscle function was one of the primary outcomes of the current study.

Data Extraction

Eligible articles were formally reviewed autonomously by 2 reviewers to collect data regarding the origin of each article, information regarding the injury and treatment, and the outcomes measures recorded. Regarding quality of life and function or disability, particular attention was directed to the Short Form 36 (SF36) and DASH, respectively, because these measures have been validated in patients with musculoskeletal injury [8,10]. We evaluated whether an assessment of patient satisfaction (using any measure) was obtained. We also evaluated whether the articles included any measure of psychosocial health (such as anxiety, regret, loss of independence, concern with appearance, and effect on personal relationships). Reported outcomes of studies were viewed in perspective of the complete cohort of papers and also sub-categorized by the continent on which the study was conducted and the time period of study publication.

RESULTS

Study Retrieval

A total of 88 papers reviewing outcomes for 5,189 patients remained for data extraction after application of all inclusion and exclusion criteria (Figure 1). 34 of the investigations were performed in Asia; 22 in Europe; 19 in North America; 9 in South America; 3 in Africa; and 1 in Australia. The median year of publication was 2007 and the mode year of publication was 2011. The earliest year of publication was 1988 and the latest year of publication was 2013. Nerve transfer was the exclusive type of treatment in 56 papers, nerve repair/grafting was the exclusive type of treatment in 6 papers, and both nerve transfer and repair were reported in 26 papers.

Overall Cohort

Within the overall cohort of 88 studies, 83 (94%) of the papers reported motor function after surgical treatment (Table 1). The British Medical Research Council (BMRC) [11] scale was used in 70 (80%) papers, while closely-related modifications of the BMRC scale were used

in 6 (7%) papers (Samardzic modification[12] in 3 papers; Terzis modification[13] in 3 papers). The Louisiana State University Medical Center (LSUMC) scale [14] (which is similar to, but not directly translatable to, the BMRC) was used in 5 (6%) papers. Two additional papers qualitatively described recovery of muscle function in a manner that could not be translated to the BMRC or LSUMC scales[15]. Of the 83 papers that reported motor function after surgery, 49 (59%) of these papers did not include any of the other recorded measures of patient outcome.

The number of studies reporting range of motion, pain, quality of life, and function or disability are reported in Table 1. One study evaluated aspects of psychosocial health, including measures of appearance, personal relationships, and discrimination[4,23].

Continent of Publication

Muscle function was reported in nearly all studies, regardless of study region. Active range of motion was less commonly reported in studies originating from Europe and North America. Function or disability, quality of life, and satisfaction were not frequently reported in all regions (none of these measures were reported in any studies from South America, Africa, or Australia), but were more commonly found in studies from North America (Table 1).

Time (Year of Publication)

Muscle function was the most commonly reported outcome measure; this did not vary across time period of publication. Studies from the earliest time period (1988 to 1995) did not include any other outcome measure. The DASH was first published in 1996 [10], and the SF-36 was validated in 1992 [8]. Active range of motion was more commonly reported as time progressive, with 46% of studies published from 2010 to 2013 including this measure. Measures of pain, function or disability, quality of life, satisfaction, and psychosocial measures were not routinely reported across all time periods, but were more commonly found in studies published after 2006 (Table 1).

DISCUSSION

The variability in reported outcomes reflects the wide variety of injury patterns and treatments for BPI and the challenge in obtaining comprehensive long-term follow-up evaluations. Motor recovery after surgery was the most widely-used outcome measure. The emphasis on reporting muscle recovery likely stems from a surgeon's desire to focus on a single, measurable outcome [6]. However, 59% (49 of 83) of the studies that reported motor recovery did not report any other outcomes.

A few investigators have attempted to use the DASH to incorporate assessment of disability after brachial plexus surgery, but it has not yet gained wide acceptance, perhaps due to the lack of validation and suitability for patients with BPI. Choi evaluated quality of life after BPI by adopting questions from general satisfaction surveys [4], and Kretschmer described a BPI survey that included 3 questions about functional improvement [5]. Although instruments such as those of Choi and Kretschmer reported outcomes beyond muscle strength and range of motion, a validated BPI survey that rigorously encompasses multiple

patient-centered outcomes (pain, quality of life, function, satisfaction, psychosocial health, etc) has yet to be developed.

It is not our intention to imply that investigators should be required to report any or all of these specific outcomes measures. The treatment of BPI is nuanced and individualized; it would be challenging, and perhaps myopic, for us to prescriptively define a battery of outcomes measures that can adequately capture the complexity of this heterogeneous group. However, we encourage investigators to expand beyond reporting only measures of muscle recovery and to include outcomes measures that encompass other aspects of recovery. In order to enhance our understanding of how brachial plexus surgery helps patients, we recommend the use of validated outcomes measures that capture domains such as pain, quality of life, function, and satisfaction. Measures of motor function merely observe checkpoints within a patient's BPI recovery. What these measures do not take into account is how the progress to those checkpoints is often mentally, physically, and emotionally challenging to patients, including pain, scarring, and inability to perform routine tasks. Therefore the development of instruments that are patient-directed will give clinicians a better understanding of the impact that BPI treatments have on their patients and allow patients to understand what the recommended brachial plexus surgery entails. We recognize that these instruments are largely limited by 2 factors. Measures such as the DASH [10] and Canadian Occupational Performance Measure [25] have not yet been validated for patients with BPI, and (2) currently-available instruments may not adequately capture the ongoing, polytraumatic experience of brachial plexus patients and the individualized nuances of restoring functional activity. These 2 areas represent opportunities for future research, ideally in multi-center and multi-cultural studies. The validation and/or development of patient-derived instruments that capture non-musculoskeletal aspects could be used in conjunction with existing clinician-derived measures to provide a multi-dimensional, comprehensive assessment of recovery in BPI patients.

The current investigation has several limitations. In our data extraction, we only described whether an outcome was reported and which type of instrument was used. Because we were not analyzing actual outcomes, we did not include descriptions of the manner in which outcomes were measured (ie: detailed descriptions of how range of motion was measured [e.g. goniometry]). The quality and consistency of measurements, particularly for the BMRC and range of motion, is known to vary [6] and must be considered when interpreting the literature. Additionally, it was not our intention to provide a systematic review or meta-analysis of the outcomes after BPI treatment. Even if we intended to do so, our ability to adequately synthesize data from studies would have been substantially limited by the inconsistency of the outcomes measures used between papers.

While it is impractical and unlikely to devise a single tool that can completely capture the nuances of each brachial plexus case, it is important that clinicians treating BPI incorporate patient-derived outcomes measures such as quality of life, function, pain, and satisfaction. Doing so will allow us to more completely capture the effect of BPI beyond the physical domain and to explore the effect of surgical treatment on these components of recovery. It is only with a comprehensive view of patient recovery that we can begin to better understand and further promote the value of brachial plexus surgery.

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FIGURE 1:
Flowchart demonstrating study selection for inclusion in systematic review.

Table 1.

Number of studies that report each type of post-operative outcome.

	Motor	Motor: BMRC	Active ROM	Passive ROM	Pain (any measure)	Pain: VAS	Quality of Life (any measure)	Quality of Life: SF36	Function or Disability	Function or Disability: DASH	Satisfaction	Psychosocial
ALL n=88	83	70	24	2	16	5	4	2	4	4	3	1
Continent of Origin (Number and percentage of studies from the continent)												
Asia (n=34)	32 (94%)	30 (88%)	11 (31%)	1 (3%)	5 (14%)	1 (3%)	0	0	1 (3%)	1 (3%)	0	0
Europe (n=22)	21 (95%)	14 (64%)	2 (10%)	1 (5%)	3 (14%)	1 (5%)	1 (5%)	1 (5%)	1 (5%)	1 (5%)	0	0
North America (n=19)	17 (89%)	13 (68%)	2 (11%)	0	5 (26%)	2 (11%)	3 (16%)	1 (5%)	2 (11%)	2 (11%)	3 (16%)	1 (5%)
South America (n=9)	9 (100%)	9 (100%)	7 (78%)	0	1 (11%)	1 (11%)	0	0	0	0	0	0
Africa (n=3)	3 (100%)	3 (100%)	2 (67%)	0	1 (33%)	0	0	0	0	0	0	0
Australia (n=1)	1 (100%)	1 (100%)	0	0	1 (100%)	0	0	0	0	0	0	0
Year of Publication (Number and percentage of studies from time period; * indicates the years prior to publication of the DASH outcomes measure in 1996 and validation of the SF-36 outcomes measure in 1992)												
1988–1995* (n=5)	5 (100%)	5 (100%)	0	0	0	0	0	0	0	0	0	0
1996–2000 (n=15)	13 (87%)	12 (80%)	1 (7%)	1 (7%)	6 (40%)	2 (13%)	1 (7%)	0	0	0	1 (7%)	0
2001–2005 (n=21)	21 (100%)	16 (76%)	5 (24%)	0	3 (14%)	0	0	0	0	0	1 (5%)	0
2006–2010 (n=23)	21 (91%)	16 (70%)	7 (30%)	0	3 (13%)	2 (9%)	2 (9%)	1 (4%)	1 (4%)	1 (4%)	1 (4%)	0
2011–2013 (n=24)	23 (96%)	21 (88%)	11 (46%)	1 (4%)	4 (17%)	1 (4%)	1 (4%)	1 (4%)	3 (13%)	3 (13%)	0	0