The Role of Amputation in Brachial Plexus Injury; A Narrative Review

Seren Jones

CARDIFF UNIVERSITY PRIFYSGOL CAERDYDD

GIG CYMRU NHS WALES

Artificial Limb & Appliance Service

Background:

Brachial Plexus Injury (BPI) refers to damage to the C5-T1 nerve roots often cause by high-energy trauma resulting in major sensory and motor deficits. The typical patient demographic is young men experiencing injury following motorcycle accidents or road traffic collisions. BPI may leave patient with a flail, painful, non-functional upper limb accompanied by neuropathic pain, altered body image and psychological burden. Impacts of BPI includes impairment to quality of life, physical disability, loss of independence and employment difficulties. An insensate limb can lead to recurrent infections, burns and trauma putting patients at risk of secondary complications. Amputation is indicated in patients with severe irreversible neurological injury, the flail limb causes interference with activities of daily living, during vascular-neural emergencies and when recurrent injuries occur due to the insensate limb. Indication is subjective and requires a multidisciplinary (MDT) approach with patient preference and request an important consideration. Amputation offers restoration of autonomy and can provide meaningful benefit in carefully selected patients.

Methodology:

A literature search was conducted with the assistance of an academic librarian. Search results included retrospective studies and case series. Outcomes were organised by theme (pain, function, prosthetic use, quality of life) due to the heterogeneity of the findings. This narrative review aims to provide a systemic synthesis of all available literature.

Aim of review:

To evaluate the role of amputation in severe BPI considering outcomes including pain, function and quality of life.

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Outcomes After Amputation in BPI:

Timing of intervention:

- Absence of MUAPs by 3 months indicated nerve degeneration is complete and recovery is unlikely [1].
- Late amputation is associated with poorer functional outcomes and early prosthetic exposure improve long-term use.
- Delayed decision making may delay a patient's adaption as rehabilitation is delayed.
- Diagnostic modalities such as Tinels's test and EMG help determine optimal timing.

Amputation level:

- Higher prosthetic uptake is seen in trans-radial amputation whilst trans-humeral is associated with lower regular use [2].
- Some patients adapt to retain adequate ADLs without a prostheses.
- Arthrodesis can be used to provide shoulder and stump stability which has influence on prosthetic tolerance.
- Level of amputation should be an MDT decision ensuring patient preference and prosthetic/functional goals are considered.

Prosthetic integration:

- Early MDT rehabilitation aids functional outcomes.
- Pre-operative prosthetic trials and assessments helps inform decision-making.
- Higher daily use is seen in patients using myoelectric devices.
- Long-term uptake is affected by joint stability, motivation and access to rehabilitation services.
- Socioeconomic factors influence prosthetic integration.

Pain:

- Chronic neuropathic pain occurs in up to 90% of patients with BPI [3].
- Amputation does not improve neuropathic pain, but mechanical pain often improves post-operatively.
- Neuropathic pain persists due to its central mechanism.
- Phantom limb phenomena is common.
- Majority of pain management evidence is small case series.
- Non-pharmaceutical pain relief options include VR, motor cortex stimulation, thalamic deep brain stimulation, stellate ganglion blocks and DREZ.

Function:

- Rehabilitation is equally important for functional outcomes as the surgery itself.
- Prosthetic use varies by amputation level.
- DASH scores show moderate reduction post-amputation.
- Microsurgery such as nerve transfers can optimise outcomes.
- Surgical delay of 9-12 months is associated with poorer functional outcomes due to muscle atrophy.
- Trans-radial amputees exhibit the highest use of prosthetic compared to wrist disarticulation being the lowest, may reflect adequate function in their residual limb for activities of daily living.

Quality of life:

- Quality of life is multidimensional, and many factors have an influence.
- Functional outcome doesn't always equal to improved quality of life.
- Chronic pain is strongly associated with depression.
- Body image and psychological impacts are significant determinants.
- Majority of patients report no regret of amputation.
- A study based on social media posts found acceptance to be a pivotal point in rehabilitation facilitating resilience and adaption through shared coping strategies and emotional support.

Conclusions:

Available literature is largely small retrospective case series reflecting the rarity of amputation. The nature of these studies make them susceptible to selection bias and heterogeneity additionally, many studies reply on subjective patient reported outcomes which are variable. Functional metrics e.g. DASH may not capture psychological and social outcomes but despite these limitations consistent evidence shows functional improvement. Currently there is a gap in the literature for randomised comparative trails making outcomes difficult to generalise across patients. An irreversible intervention such as amputation requires psychological counselling, MDT discussions and correctly informing patients of the post-operative expectations. Amputation can offer patients relief from mechanical pain, functional gains and an improved quality of life. These outcomes are multidimensional and unpredictable highlighting the importance of pre-operative counselling, rehabilitation access and patient motivation. Trans-radial amputees were found to adhere to prosthetics more compared to proximal levels. Importantly, despite a relief in terms of mechanical pain, neuropathic pain and phantom limb phenomena may remain. Ultimately, amputation should be a multidisciplinary decisions aligned with the patient's goals offering patients autonomy, adaption and a restored independence.

References:

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