

Three core surgical procedures for obstetric brachial plexus injury

Dr Rahul Nath, MD is a Reconstructive Microsurgeon and the Director of Texas Nerve and Paralysis Institute in Houston, USA. His work focuses on using novel surgical approaches to improve the quality of life of patients suffering from obstetric brachial plexus injury.

recommend reserving nerve reconstruction for the most severe cases, and prefer to address secondary complications, such as muscle and bone deformities, rather than automatically involving the nervous system.

Obstetric brachial plexus injury (OBPI) is a nerve injury that affects the brachial plexus, a network of nerve fibres that supplies the skin and musculature of the upper limbs. The incidence of OBPI in the USA is between 0.5 and 4.6 per 1000 live births. Perinatal risk factors include infants of increased weight-for-gestational-age, multiparous pregnancies, prolonged labour and breech and difficult deliveries. Although spontaneous recovery occurs in many cases, some will face difficulties in performing daily activities, especially those involving abduction or external rotation of the shoulder. Poor recovery in OBPI results in muscle weakness

and imbalances around the shoulder. Progressive muscle imbalance can lead to the development of bony deformities at the shoulder joint, affecting its movement and function.

Traditional approaches involve nerve transfer, contracture release and nerve decompression, but often fail to address the scapular hypoplasia, elevation and rotation (SHEAR) deformity. Dr Nath found that permanent OBPI patients who had nerve reconstruction, developed more shoulder abnormalities and required more surgeries than OBPI patients who did not undergo nerve reconstruction. Therefore, the group at the Texas Nerve and Paralysis Institute

As the brachial plexus injury tends to be asymmetric, muscle imbalances around the shoulder often develop, as well as other secondary deformities, such as rotation or twisting of the shoulder, collarbone or elbow. Dr Nath and his team use surgical corrections to improve the clinical and functional ability of the upper limbs, in order to allow patients to have a normal daily routine.

THE MODIFIED QUAD PROCEDURE

The modified Quad procedure (modQuad) was first implemented by Dr Nath and his team in 1996 and is based on the following steps:

- 1 Transfer of the muscles of the shoulder (releasing, re-positioning and suturing the shoulder muscles to enable shoulder rotation and to stabilise the shoulder blade).
- 2 Releasing contractures of muscles (caused by the shortening or tightening of muscles).
- 3 Nerve decompression (to treat and release nerves that have become compressed by their surrounding structures).
- 4 Neurolysis (which interrupts the transmission of nerve signals).

Using modQuad to release the tightening and shortening of muscles, the team were able to improve shoulder mobility of OBPI patients. They reported the outcomes of 98 patients, with a mean age of 2.5 years, who underwent modQuad surgery and found that after a mean follow up period of 4.8 years, the patients had a marked improvement in the abduction of the shoulder. Shoulder abduction is the process of moving the arm away from the body and above the head, as when doing jumping jacks, and is normally 180°. In the patients mentioned above, their mean shoulder abduction prior to the surgery was 45°,

Pre-triangle tilt (Affected side – Left)



Post-triangle tilt



Figure 1: Modified Mallet functions performed by an obstetric brachial plexus palsy child, who had surgeries at other clinics before presenting to us (upper panels) and the same child, at least one-year after having modQuad and triangle tilt as revision surgeries at our clinic (lower panels).

Although spontaneous recovery occurs in many cases, some will face difficulties in performing daily activities, especially those involving abduction or external rotation of the shoulder ”

which increased to a mean of 162° after the surgery.

Whilst modQuad addresses poor shoulder abduction, it is less effective in correcting bone deformities, such as shoulder joint incongruity or SHEAR deformities. This is where another approach, triangle tilt, comes in.

TRIANGLE TILT

Whilst traditional soft tissue surgeries do not correct the bony deformities resulting due to muscle imbalances, therefore another approach used by Dr Nath's team is 'triangle tilt'. Triangle tilt is a surgical procedure targeting bone abnormalities of the shoulder in OBPI patients, something that is not done by any other surgical treatment. It involves ostomies (removal of bone) of the triangle of bones that make up the shoulder joint, in order to improve the positioning and functionality of the shoulder. In the long term, these surgical corrections will improve shoulder strength and function.

A retrospective study done by Dr Nath and a biomedical researcher in his team, Chandra Somasundaram, analysed the improvement of ten male and ten female patients with OBPI following either triangle tilt or modQuad revision surgery, following previous surgery at different clinics. The analysis showed that indeed, triangle tilt and modQuad surgical procedures are suitable revision procedures which result in improved anatomical measurements of the shoulder, such as rotation. Overall, they conclude that modQuad and triangle tilt can be used as successful revision surgical procedures in patients who have undergone procedures at other clinics before presenting to Dr Nath.

The benefits of triangle tilt surgery can be assessed through a questionnaire called the Pediatric Outcomes Data Collection Instrument (PODCI). This tool was developed in 1994 to assess pain, function and happiness in children with musculoskeletal disorders. This was done by Dr Nath and his team to evaluate the benefits of triangle tilt surgery to OBPI patients. Indeed, significantly higher PODCI scores were observed in parameters relating to upper extremity function, physical function and basic mobility compared to pre-triangle tilt surgery.

BICEP TENDON LENGTHENING

Patients with permanent OBPI can develop persistent bicep contracture and loss of extension of the elbow if they do not

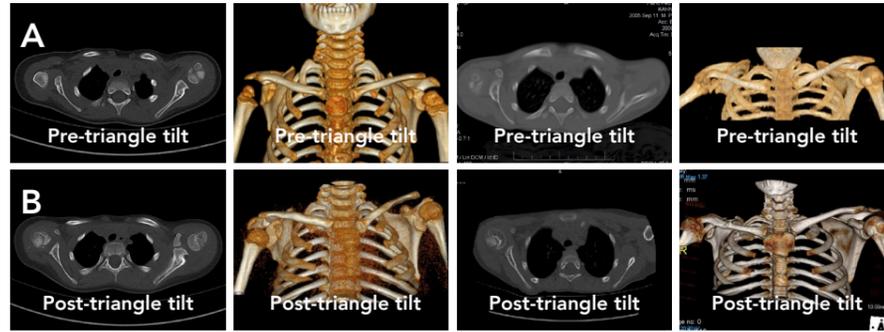


Figure 2: Comparison of computed tomography images of obstetric brachial plexus palsy children, who had surgeries at other clinics before presenting to Dr Nath (A) and the computed tomography images of the same children at least one-year after having triangle tilt as revision surgery at the Institute (B).

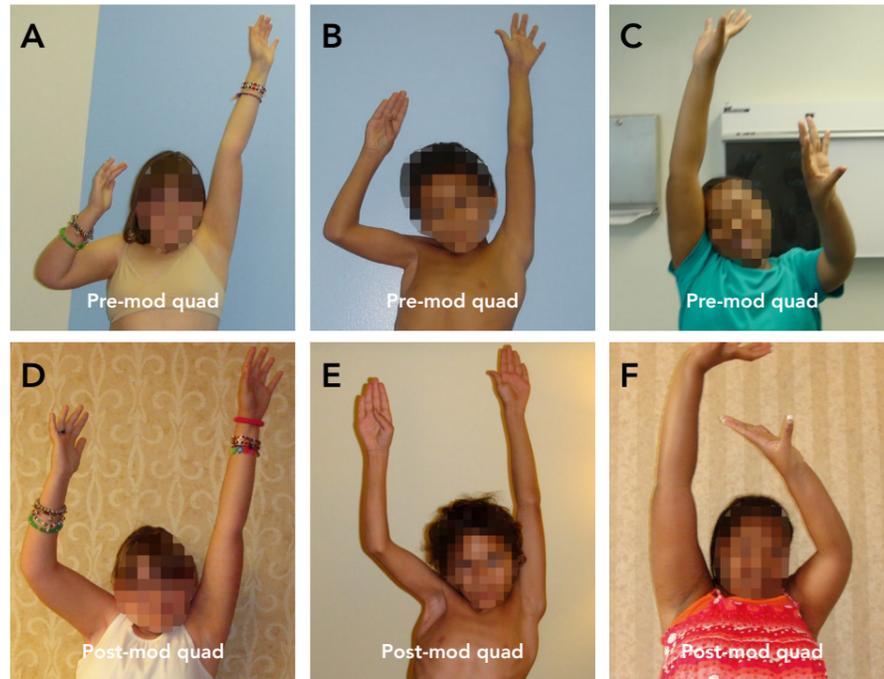


Figure 3: Comparisons of pre-operative (A-C) and post-operative (D-F) shoulder abduction in pre-teen and teen patients with obstetric brachial plexus injury.



Figure 4: The outcome of serial casting versus BTL (biceps tendon lengthening) in a 12-year-old OBPI (obstetric brachial plexus injury) girl (left panel) and a 10-year-old OBPI boy (right panel). Pictures A and D show before serial casting. Pictures B and E show after serial casting but before BTL surgery. Pictures C and F show after BTL surgery.

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Q&A

How did you first become interested in OBPI?

I was interested in neuroanatomy and physiology in medical school and researched areas of clinical medicine that were not being adequately addressed with current technology and thought. In addition, it was important to me to work with children and so the confluence of these interests happened to be OBPI.

What would you like to see become the 'gold standard' for treating OBPI?

"Gold" Standards in medicine should be based on statistical evidence that the approach of interest is effective. In 20+ years of active research into OBPI management, my team (which since 2004 has included PhD researchers) has shown that function, anatomy and quality of life are all improved with the surgical techniques we use at the Institute. Additionally, we have shown that our techniques statistically improve outcomes from traditional or older surgical techniques.

Many of your approaches are used as revision surgeries, do you think they should be used in the first place to avoid the need for additional surgeries? How would you advocate this/change the current mindset? I believe that our

techniques should be a front-line treatment for OBPI patients that meet our strict criteria for surgical management. Our approach to educating others about the effectiveness of our techniques has always been to use the strictest scientific and statistical results to validate them. I believe this is the best way to change attitudes toward OBPI surgical management.

Can your nerve reconstruction techniques be applied to disorders other than OBPI?

Certainly, there are a range of nerve injuries and the secondary consequences of such nerve injuries that do benefit from techniques similar to those we employ in OBPI. Examples include traumatic brachial plexus injuries in adults, many other peripheral nerve injuries, and foot drop.

What is the future in terms of the next generation of surgical interventions to treat OBPI?

Our surgical core techniques have not changed radically for many years since they are statistically proven. However, robotic surgical modalities and adjuvant molecular biologic treatments are likely to have important future impacts on OBPI management.

Dr Nath has demonstrated that biceps tendon lengthening (BTL) could improve arm length significantly in these patients



fully recover. The reported prevalence of elbow flexion contractures in OBPI patients can range from 4.6% to 98.5%. Surgical procedures, such as modQuad and triangle tilt do not address the shortening of the elbow joint during flexion (the opposite of extension) and the resulting shortened arm length. Serial casting and splinting are not effective in correcting this shorting, or contracture of the elbow flexion. Dr Nath has demonstrated a significant reduction of the contractures of the affected elbow (by approximately 30°) and improvement in

arm length after bicep tendon lengthening surgery in ten OBPI patients, who had previously been resistant to serial casting approaches.

Dr Nath has been responsible for the implementation of several novel surgical approaches which have tangible effects on the lives of children with OBPI and he continues to run clinics to assess and discuss treatment options for OBPI patients in the US (www.drathclinics.com/).

Detail



RESEARCH OBJECTIVES

Dr Nath's research compares outcomes of revision surgical operations in obstetric brachial plexus (OBPI) patients to results of conventional operative procedures at other institutions to see if this has improved the patients' quality of life post-surgery.

FUNDING

NIH

BIO

Dr Nath serves as a Reconstructive Microsurgeon and as the Director of Texas Nerve and Paralysis Institute at Houston, USA. He received his MD degree in 1988 from Northwestern University, The Feinberg School of Medicine, Chicago. This was followed by an internship and residency at Northwestern and at the Department of Surgery in plastic and reconstructive surgery, Washington University in St. Louis, followed by two fellowship years in peripheral nerve injury. He joined the Faculty at Baylor College of Medicine in 1996, and he served there until 2004.



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