**RESULTS:** All three groups showed a tendency for restricted passive ER on the affected limb relative to the unaffected limb at 4 and 8 weeks (preganglionic at 4 weeks p = 0.1, 8 weeks p = 0.12; postganglionic and sham p < 0.05 at 4 and 8 weeks). The preganglionic group had the least restriction in ER (4-week mean = -19.45°; 8 week mean = 13.24°) and postganglionic group had the most ER restriction (4 week mean = -62.72°; 8 week mean = -52.60°) (Fig 1). Severely reduced muscle mass in anterior deltoid, spinal deltoid, biceps long head, biceps short head, subscapularis, supraspinatus, infraspinatus and teres major was observed on the affected shoulder muscles compared to the unaffected shoulder in the preganglionic group (p < 0.05). Reduced muscle mass (Fig. 2) on the affected side relative to unaffected side in postganglionic group was observed only in pectoralis major, anterior deltoid, spinal deltoid, bicep long and triceps. Muscle mass was significantly lower in the postganglionic group relative to postganglionic especially in biceps short head, supraspinatus and infraspinatus (p < 0.05). Differences in optimal muscle length (Fig. 3) between the affected and unaffected limb, an indicator of restricted longitudinal muscle growth, was observed in the majority of the muscles in the preganglionic group, with p < 0.05 in supraspinatus, infraspinatus and teres major. This difference was less marked in postganglionic group muscles with only supraspinatus and infraspinatus showing significantly lower (p < 0.05) optimal fiber lengths.

**DISCUSSION:** The postganglionic group exhibited severe restriction in passive ER relative to the preganglionic group [5]. This was also consistent with severe contractures in internal rotation and elbow flexion described in previous studies [2]. ROM is not substantially affected due to preganglionic nature of injuries (e.g. C5-6 nerve root avulsion or nerve root ruptures) due to notable absence of contractures [3]. Computational simulations exhibiting loss of contractures through muscle imbalance have also seen lower effects on ROM as opposed to other mechanisms causing higher contractures [7]. It was previously suggested that preservation ofafferent innervation in preganglionic injuries may protect against contractures, and it has been shown to preserve muscle spindle development [2]. However, in the current study, muscle longitudinal growth was severely restricted in the preganglionic group. Other possible explanations for the lower ER restriction in the preganglionic group include the significantly lower muscle mass surrounding the shoulder joint, which may reduce joint stiffness, or the lack of incision in pectoralis major due to the supraclavicular approach. The difference in the muscle mass could therefore be responsible for the difference in shoulder and elbow contractures in the two injury groups, as opposed to differences in optimal muscle length. This work clarifies structural changes to muscle following NBPI, which plays a role in understanding the loads acting on the shoulder joint that contribute to osseous deformities.

**SIGNIFICANCE/CLINICAL RELEVANCE:** The study provides important insight into the differential effects of nerve injury location in NBPI and its effects on range of motion at the shoulder and the impact on muscle growth and structure. This work provides new evidence critical for understanding the underlying contributions to shoulder and elbow contractures causing deformity and loss of function at the shoulder in NBPI.

**REFERENCES:**


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