INTRODUCTION

Scapular winging, muscle weakness, chronic discomfort, and overall impairment of shoulder function are commonly caused by injuries to and/or compression of the upper brachial plexus, long thoracic, and accessory nerves. Injury to the long thoracic nerve (LTN), which arises from the roots of the fifth, sixth, and seventh cervical nerves (C5–C7), is the most common cause of scapular winging. Because the LTN is long, thin, and runs superficially to the serratus anterior (SA) muscle, rendering it vulnerable to trauma. Injury to the LTN can cause weakness or paralysis of the SA muscle, which stabilizes the scapula and supports the shoulder abduction. Repeated use of strong forces, such as muscle strengthening exercises can cause soft tissue damage and dysfunction of the shoulder joints in adults. The compensatory muscle activity required to maintain the scapular mobility is associated with pain, spasm, and tendonitis around the shoulder joint. Timely diagnosis and management can reduce a significant loss of activity time or recurrence, leading to further disability. Nonoperative treatment includes medical and physical therapy. Surgical treatments are neurolysis, transposition, neurorrhaphy, nerve transfer, and tendon transfer.
Here, we report the anatomical and functional improvements in 21 sports and recreational related upper extremity-musculoskeletal disorders in adult patients after decompression and neurolysis of the upper brachial plexus and LTNs.

MATERIALS AND METHODS

Twenty-one patients (a bilateral injury in two patients and 23 shoulder surgeries) underwent surgeries and postoperative evaluations. The mean time interval between the onset of injury and surgery was 2.3 years. Preoperatively, the extent of scapula winging was severe in 10 of 21 patients (48%) and moderate in other 11 of 21 patients (52%) [Table 1]. Nerve conduction velocity and electromyography examination reports were obtained for the patients to assess the regional sensory or motor loss of the nerve injury.

Surgery

An incision was created over the area where the LTN exited through the middle scalene muscle, about 3 cm superior to the upper clavicular border. The supraclavicular nerves were identified and retracted laterally. The upper trunk of the brachial plexus was identified deep in the anterior scalene fat pad; the fat pad was retracted, and the underlying upper trunk of the brachial plexus was identified. There was epineural scarring that was released sharply. The substance of the upper trunk was entered, and the perineurium was dissected using microsurgical instrumentation and high magnification. Major fascicle groups were separated through internal neurolysis to decompress the upper trunk internally. The upper trunk was decompressed surgically with partial release/excision of the anterior scalene muscle and dissected around the lateral and posterior aspects of the upper trunk - (i.e. where the LTN exited the middle scalene muscle). The LTN also noted to have an hourglass-shaped impingement at this exit point, and the nerve was circumferentially neurolysed. The perineurium of the LTN was then dissected; several fascicles were separated using internal microneurolysis. In addition, the middle scalene muscle was resected partially to decompress the LTN.

Statistical tests included; the paired Student's t-test with Analyze-it 2.12 software in Excel 2003 (Analyze-it, Leeds, UK; Microsoft, Redmond, WA). A value of \( P < 0.05 \) was considered statistically significant.

RESULTS

Postoperative clinical assessment

The anatomical appearance of the winged scapula improved significantly in 20 of 21 patients (96%) after the surgery [Table 1 and Figure 1]. Eleven of 21 patients (52%) had
restoration of a near healthy appearance of the scapula. All except one patient showed remarkable recovery of the affected shoulder functions [Table 1 and Figure 1]. Fifteen of 21 (71%) patients recovered full range of motion (180°), and the mean shoulder abduction and flexion improved significantly postoperatively (P < 0.001) while the extent winging of the scapula scores also significantly improved [Table 1].

DISCUSSION

The LTN injury and paralysis of the SA muscle are well documented in professional athletic and non-professional sports and recreational-related activities. Muscle-strengthening exercise such as weightlifting is more likely to cause shoulder damage in adults, while sports-related activities can cause shoulder injury in youth [Tables 2 and 3]. In general, an early surgery of the affected nerve provides a better outcome. Recently, Camp and Birch[2] reported no correlation between delays in surgeries and postoperative shoulder movements in 111 nerve injury patients. They also found a delay of over 40 months for a patient who still had a good functional outcome, whereas Ng and Wu[6] found none of their patients recovered fully if the duration of winging lasted over 3 years. However, approximately half of their patients with serratus anterior muscle dysfunction were due to neuralgic amyotrophy (NA), and these NA patients had a worse severity of winging than the patients with traumatic cause. Of 21 patients in our report, 14 patients had over 1 year between the onset of injury and surgery. The other seven patients underwent surgery less than a year after the onset of the injury. The improvement in shoulder abduction and flexion in these two groups of our patients were about the same (>120 and reached up to 180°) postoperatively [Table 3].

Göransson et al.[3] reported a greater improvement of 44° in shoulder abduction in winged scapula patients who underwent neurolysis compared to nerve-grafting (30°). All 21 patients in our report underwent decompression and neurolysis; the improvement was >120°. Fifteen patients achieved full range of motion (180°) postoperatively.

| Table 2: Physical activities (exercise, sport, and recreational-related) that caused the shoulder disability in our study. |
|-----------------|-----------------|-----------------|
| S. No.          | Physical activity                                                                 | Number of patients |
| 1.              | Weightlifting                                             | 57 (49%)         |
| 2.              | Exercise                                                  | 20 (17%)         |
| 3.              | Swimming                                                  | 5 (4.3%)         |
| 4.              | Water skiing, boarding and surfing                        | 4 (3.4%)         |

There are three patients (2.6%) in each of the activities in parenthesis (Yoga, Cycling/Biking, Baseball, Tennis, and football), and two patients (1.7%) in each of the following activities: Basketball, Golf, Skiing, and Wrestling. There is one patient (0.9%) in each of the following activities: Volleyball, Playing pool, Kickboxing, Bow Hunting, Bowling, gymnastics, and Rugby. Total - 116.

| Table 3: Incidence of shoulder injury in adult versus youth in our study. |
|-----------------|-----------------|-----------------|
| Physical activity | Adult patients | Youth patients |
| Weightlifting   | 57 (84%)        | 11 (16%)        |
| Sport-related activities | 39 (48%)        | 42 (52%)        |
| Exercises       | 20 (51%)        | 19 (49%)        |

Figure 1: (a and b) A 50-year-old male patient who had winging scapula and shoulder disability due to weightlifting. (c) Postoperative photograph showing recovery of the winged scapula/full active range of motion (shoulder abduction of 180°).
CONCLUSION

Twenty of the 21 patients in this report achieved functional shoulder movements and a healthy appearance of the scapula after decompression, and neurolysis of the upper brachial plexus and LTNs, with partial resection of the scalene muscles.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

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Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Ahearn BM, Starr HM, Seiler JG. Traumatic brachial plexopathy in athletes: Current concepts for diagnosis and management of stingers. J Am Acad Orthop Surg 2019;27:677-84.
2. Camp SJ, Birch R. Injuries to the spinal accessory nerve: A lesson to surgeons. J Bone Joint Surg Br 2011;93:62-7.
3. Göransson H, Leppänen OV, Vastamäki M. Patient outcome after surgical management of the spinal accessory nerve injury: A long-term follow-up study. SAGE Open Med 2016;4:2050312116645731.
4. Maak TG, Osei D, Delos D, Taylor S, Warren RF, Weiland AJ. Peripheral nerve injuries in sports-related surgery: Presentation, evaluation, and management: AAOS exhibit selection. J Bone Joint Surg Am 2012;94:e121.
5. Martin RM, Fish DE. Scapular winging: Anatomical review, diagnosis, and treatments. Curr Rev Musculoskelet Med 2008;1:1-11.
6. Ng CY, Wu F. Scapular winging secondary to serratus anterior dysfunction: Analysis of clinical presentations and etiology in a consecutive series of 96 patients. J Shoulder Elb Surg 2021;2021:S1058-2746(21)00153-1.
7. Raksakulkiat R, Leechavengvongs S, Malungpaishrope K, Uerpairojkit C, Witoonchart K, Chongthammakun S. Restoration of winged scapula in upper arm type brachial plexus injury: Anatomic feasibility. J Med Assoc Thai 2009;92 Suppl 6:S244-50.
8. Seth A, Dong M, Matias R, Delp S. Muscle contributions to upper-extremity movement and work from a musculoskeletal model of the human shoulder. Front Neurorobot 2019;13:90.

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