SCIENTIFIC ARTICLE

Abduction in Internal Rotation: A Test for the Diagnosis of Axillary Nerve Palsy

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Purpose To describe and validate the use of a test of abduction in internal rotation for the assessment of axillary nerve injury.

Methods A total of 14 male patients with a mean age of 29 years (SD ±6 y), with axillary nerve lesions lasting an average of 6 months, participated. We measured their shoulder range of motion. In the upright position, with the trunk bending forward, we asked our patients to actively extend the shoulder (swallowtail test), and then we extended the shoulders and asked each patient to hold them in that position (deltoid extension lag test). For the abduction in internal rotation test, we asked patients to abduct the shoulder in internal rotation. If full abduction compared with the normal contralateral side was not possible, the examiner passively held the affected limb in maximal abduction and internal rotation. The patient was instructed to maintain the position when the examiner released the limb. In each test, any lag compared with the normal side accounted for deltoid palsy.

Results All patients exhibited abduction beyond horizontal and full external rotation. The swallowtail test and the deltoid extension lag test identified the axillary nerve lesion in 10 of 14 patients. The abduction in internal rotation test recognized the axillary nerve injury in all 14. The average difference in the range of abduction in internal rotation between the normal and affected side was 37° (abduction lag).

Conclusions Compensatory abduction in axillary nerve palsy has been attributed to the action of the supraspinatus, biceps, coracobrachialis, and pectoralis major. During abduction in internal rotation, compensatory abduction is impaired, clearly indicating deltoid muscle dysfunction. *(J Hand Surg 2011;36A:2017–2023.*

Type of study/level of evidence Diagnostic II.

Key words Axillary nerve, abduction in internal rotation test, nerve graft, axillary nerve palsy.

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THE AXILLARY NERVE IS susceptible to both stretch injuries and direct trauma. The nerve experiences stretch injury during shoulder dislocations because it crosses the inferior border of the humeral head from anterior to posterior.[1] Direct trauma can be either accidental or iatrogenic; the latter is sustained during surgical procedures including arthroscopy, shoulder stabilization, and rotator cuff repair.[2]

Palsies of the axillary nerve are not readily diagnosed because many patients preserve a full range of abduction and external rotation.[3] Manual examination to assess abduction strength is 1 way to detect axillary

nerve paralysis; however, subtle differences in strength cannot be measured reliably, and hypertrophy of the supraspinatus muscle can improve abduction strength, thereby masking deltoid weakness.[2] Visible deltoid atrophy is an important finding in the diagnosis of axillary nerve lesions, but it is a late finding that further contributes to the delayed diagnosis of axillary nerve palsy and consequent late treatment and suboptimal outcome.[4] With lesions affecting the axillary nerve, sensation in the upper arm is usually but not always impaired.[5]

These limitations in the detection of axillary nerve lesions by clinical examination have caused surgeons to consider surgical repair based on the results of electromyography. For example, if signs of reinnervation are detected within 3 months of injury, surgery is not recommended.[6,7] This approach may be misleading, however, because many patients with electrophysiological signs of deltoid reinnervation fail to progress to a useful clinical recovery.[8] Hence, making a diagnosis based on an electromyogram without clinical correlation may not be advisable. Interest is thus growing in developing more clinically relevant tests to assess deltoid function.

Two tests have been described to assess deltoid function: the swallowtail test[9] and the deltoid extension lag test,[10] both of which examine shoulder extension. With the swallowtail test, shoulder extension is performed actively; with the deltoid extension lag test, the examiner passively extends the shoulder. In 2 recent publications,[11,12] the deltoid extension lag test was used to evaluate injuries of the axillary nerve.

When the deltoid is paralyzed, the supraspinatus, coracobrachialis, biceps, pectoralis major, and triceps long head can perform compensatory abduction with the shoulder externally rotated.[13] We hypothesized that testing abduction in internal rotation with the elbow flexed would eliminate compensatory abduction. During internal rotation, the insertion of the supraspinatus muscle, the main initiator of abduction,[14,15] is displaced anteriorly. In this position, the moment arm for the supraspinatus to abduct the shoulder is unfavorable. The same is applicable to the pectoralis major, biceps long head, and coracobrachialis. In internal rotation, the triceps long head may produce abduction, which is reduced with elbow flexion.

The objective of the present study was to propose and validate the abduction in internal rotation test for the diagnosis of axillary nerve palsies.

PATIENTS AND METHODS

In advance of data collection, the local ethics committee approved the protocol of the present study. Patients provided written informed consent before participating, in accordance with the Declaration of Helsinki, which guides biomedical research involving human subjects.

From December 2008 to December 2010, we examined 22 patients with suspected axillary nerve injuries at our hospital. We excluded from the study 4 patients with passive limitation of shoulder abduction and 4 with an associated lesion of the suprascapular nerve revealed by electromyogram. This left us with 14 men with a mean age of 29 years (SD ±6 y). In all patients, the contralateral limb was unaffected. Electromyograms, performed at least 3 months after injury, confirmed deltoid muscle denervation without evidence of reinnervation in all patients. We excluded, by clinical and electromyographic examination, any injury to the roots of the brachial plexus. Radiographic evaluation of the shoulder indicated the absence of fractures around the shoulder girdle. Sonographic assessment demonstrated integrity of the rotator cuff in all patients.

We examined the patients on the day before surgery for axillary nerve repair, which was performed an average of 6 months (SD ±1.5 mo) after trauma. Patients were asked about shoulder pain, fatiguability, and any other disturbing symptoms.

Full passive range of shoulder motion was present in all patients bilaterally. We measured active shoulder abduction and external rotation with a goniometer. External rotation was measured with the shoulder at 0° of abduction and the elbow flexed and held against the patient's side. Afterward, we evaluated patients by means of the swallowtail test, followed by the deltoid extension lag test, and then the abduction in internal rotation test.

Swallowtail test

We asked patients to stand with the trunk bending forward, and to actively extend the shoulder with the elbow extended and then with the elbow flexed (Figs. 1, 2). To ensure voluntary maximal shoulder extension, we asked patients to bend the trunk forward. If at least 20° of difference existed between the normal and contralateral side in the range of shoulder extension, the test was deemed positive.

Deltoid extension lag test

We passively extended both shoulders and elbows maximally and asked each patient to hold them in that position (Fig. 3). We documented the incapacity to maintain this position with photographs and measured the extension lag.