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Clinical Outcomes Following Decompression of the Nerve to the Teres Minor in Patients with Idiopathic Isolated Teres Minor Fatty Atrophy

Lisa M. Kruse, MD, Ken Yamaguchi, MD, Jay D. Keener, MD, and Aaron M. Chamberlain, MD

Shoulder & Elbow Service, Washington University Orthopedics, Barnes Jewish Hospital, St. Louis, MO, USA

Abstract

Background—The purpose of this manuscript is to describe what we believe to be the first series of patients surgically treated for idiopathic isolated teres minor atrophy and present the results of surgical decompression of the nerve to the teres minor.

Methods—This is a retrospective cohort of 22 patients who underwent decompression of the nerve to the teres minor for isolated teres minor atrophy. Clinical data including duration of symptoms, additional diagnoses, concurrent procedures, preoperative physical examination, imaging data, and preoperative VAS, SST, and ASES scores were collected from the medical record. Post-operative patient-based clinical outcome measures including VAS, SST and ASES scores were obtained during clinical examination or by telephone interview.

Results—Average length of follow up was 26 months. Nine patients had concurrent procedures performed. Preoperatively 12/14 (86%) had external rotation weakness in Hornblower's position. Post-operatively pain scores decreased an average four points; ASES scores increased 31.7 ± 20.2 points; SST scores increased 3.1 ± 2.3 points. No external rotation weakness was noted post-

Corresponding Author: Aaron M. Chamberlain, M.D., Shoulder & Elbow Service, Washington University Orthopedics, Barnes Jewish Hospital, 660 S. Euclid Ave. Campus Box 8233, St. Louis, MO 63110, USA. chamberlaina@wustl.edu.

Lisa M. Kruse, M.D.: The author, their immediate family, and any research foundation with which they are affiliated have not received any financial payments or other benefits from any commercial entity related to the subject of this article.

Ken Yamaguchi, M.D.: The author, their immediate family, and any research foundation with which they are affiliated have not received any financial payments or other benefits from any commercial entity related to the subject of this article.

Jay D. Keener, M.D.: The author, their immediate family, and any research foundation with which they are affiliated have not received any financial payments or other benefits from any commercial entity related to the subject of this article.

Aaron M. Chamberlain, M.D.: The author, their immediate family, and any research foundation with which they are affiliated have not received any financial payments or other benefits from any commercial entity related to the subject of this article.

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operatively in any tested patient. Two patients developed adhesive capsulitis. No other complications occurred.

Conclusions—Isolated compression of the nerve to the teres minor compression is a rare and novel clinical entity, and in properly selected cases, open release of the fascial sling enveloping the nerve branches to the teres minor can provide relief of symptoms and clinical improvement.

Keywords

isolated teres minor atrophy; decompression nerve to teres minor

Introduction

Isolated teres minor atrophy is a recently described and potentially important clinical entity¹. The main clinical presentation includes: posterior shoulder pain, weakness of abducted external rotation (hornblower's position), isolated teres minor atrophy on MRI or ultrasonography, and/or isolated teres minor involvement on EMG⁴. This is a separate entity from quadrilateral space syndrome as it occurs without involvement of the axillary nerve and deltoid on exam or imaging. Here we describe what we believe is the first series of patient with idiopathic isolated teres minor atrophy and present the results of surgical decompression of the nerve to teres minor.

Teres minor atrophy can occur in association with massive rotator cuff tears, in quadrilateral space syndrome, or in isolation. Previous imaging studies have found a 3% incidence of isolated teres minor atrophy in routine magnetic resonance imaging (MRI) of the shoulder¹² and 0.8% in all shoulder MRIs in another study⁵. Sofka et al noted isolated teres minor atrophy in 8 of 199 patients (4%) referred for shoulder ultrasound (US) with no teres minor tears¹¹. In another series, 2% of 2031 consecutive shoulder ultrasounds showed isolated teres minor atrophy⁴.

Fibrous bands in the quadrilateral space have been suggested as an etiology of isolated teres minor atrophy^{1; 10}. An anatomical study by Chafik et al³ described two variants of fascial anatomy in the teres minor: 11/23 specimens had an individual fascial compartment enveloping the teres minor and 12 specimens had no circumferential individual compartment. Both variants had a stout fascial sling consisting of contributions from fascia of the deltoid, infraspinatus, teres minor, and long head of the triceps that attached to the inferior aspect of the glenoid neck. The primary motor nerve to the teres minor travels from extrafascial to subfascial at this point before entering the teres minor. This study suggests the fascial sling present in all specimens as a site of potential compression or tethering of the nerve to the teres minor. Friend et al⁷ dissected eight cadaveric specimens and found considerable variation in the origin and length of the nerve to the teres minor. They suggested this increases the risk of impingement and subsequent isolated teres minor atrophy.

Decompression of the quadrilateral space has shown promising results in the treatment of quadrilateral space syndrome^{2; 10}. No prior study to our knowledge has reported results of surgical decompression for isolated teres minor atrophy.

The purpose of this manuscript is to describe what we believe to be the first series of patients surgically treated for idiopathic isolated teres minor atrophy and present the results of surgical decompression of the nerve to the teres minor. We hypothesize that idiopathic isolated teres minor atrophy is a distinct clinical entity and decompression of the nerve to the teres minor in these patients can result in improved pain and function.

Materials and Methods

This retrospective study was performed after approval from the Washington University in St. Louis Institutional Review Board Human Studies Committee (IRB approval #201110255), and all participants signed an informed consent form or gave verbal consent to participate. Twenty-seven consecutive patients who underwent decompression of the nerve to the teres minor for idiopathic isolated teres minor atrophy between June 2008 and January 2012 by one of three fellowship trained shoulder and elbow surgeons were eligible for the study. Patients were identified through a search of the participating surgeons' billing records. Patients were considered to have idiopathic teres minor atrophy if they had resting or activity related posterior shoulder pain combined with evidence of fatty degeneration of the teres minor on MRI or ultrasound without fatty degeneration of the other rotator cuff muscles. Patients with isolated teres minor involvement with EMG testing were also included. A suggestive physical examination finding included weakness with external rotation strength testing with the arm in an abducted and externally rotated position. Patients were excluded if they had a massive rotator cuff tear which included the teres minor, cervical spine disease, neurological disorder, or fatty infiltration of other rotator cuff muscles on ultrasound or MRI (Goutallier grade one or greater)⁸. Patients with associated partial-thickness or full-thickness rotator cuff tears of the supraspinatus or infraspinatus without teres minor involvement or biceps tendon pathology were included in the study. Patients with concurrent adhesive capsulitis or mild osteoarthritis were included in the study as well if they met the criteria for teres minor atrophy as a separate clinical entity.

Patient data including demographics, concurrent diagnoses, pre-operative duration of symptoms, pre-operative physical exam, MRI, US, EMG, visual analog scale for pain (VAS pain), American Shoulder and Elbow Society score (ASES), and Simple Shoulder Test score (SST), and operative procedures performed were obtained through retrospective chart review. All patients with shoulder pain were asked to complete VAS, ASES and SST questionnaires at the time of initial evaluation. Not all physical exam data or questionnaire data were available for all patients. Pre-operative EMG/NCV studies were performed in nineteen patients. EMG/NCV studies were performed under ultrasound guidance for insertion of the fine needle into the teres minor muscle belly. EMG/NCV study findings were considered to be consistent with chronic denervation of the teres minor if they had prolonged distal onset latency in the posterior axillary motor nerve greater than 5 milliseconds, decreased teres minor recruitment, increased or abnormal spontaneous activity, or reproduction of symptoms with needle insertion and teres minor testing. Pre-operative ultrasound examination was performed in nineteen patients. All ultrasound examinations were performed by trained musculoskeletal sonographers and read by fellowship trained musculoskeletal radiologists at our institution. Pre-operative MRI examination was performed in nineteen patients. MRI findings of fatty degeneration were

graded according to the Goutallier classification⁸. Post-operative physical exam was obtained via retrospective chart review or follow-up examination when possible. Patient-based clinical outcome measures including VAS, SST and ASES scores were obtained by clinical examination or by telephone interview. Follow up was obtained in 22 patients (85%); see figure 1.

Surgical technique

Francel et al previously described a technique for decompression of the axillary nerve in quadrilateral space syndrome⁶. A modification of this technique was used and is described in figure 2. The patient was positioned in either the beach-chair position if concomitant shoulder arthroscopy was performed or the lateral position for isolated decompression. The arm was prepped free. A posterior-inferior axillary incision was made followed by blunt dissection down to the deltoid fascia. The deltoid was elevated superolaterally and the interval between the teres minor and teres major was identified. The teres minor muscle belly was gently retracted superiorly revealing the primary motor nerve to the teres minor medially and inferiorly. The nerve was then traced laterally along its course on the inferior surface of the muscle belly toward the quadrilateral space. The fascia overlying the teres minor was incised from medial to lateral and completely released along the entire course of the nerve.

Statistical Analysis

A p-value of <0.05 indicated significance unless otherwise noted. Paired Student T-test was used for analysis of continuous data and the chi-squared test was used for categorical data. All statistical analyses were completed using Excel (Microsoft, Redmond, WA, USA).

Results

Demographics

Of the twenty-seven patients who underwent decompression of the nerve to the teres minor during the study period we were able to obtain follow up data on twenty-two patients (Figure 1). Twenty of these patients were male. The patients' average age (years) at the time of surgery was 52.2 ± 9.2 (range 24-68). These patients described symptoms prior to surgery ranging from 3 to 192 months (average 24 ± 39 months). Along with compression of the nerve to the teres minor, patients were also diagnosed with adhesive capsulitis (4), rotator cuff tears (6), osteoarthritis (3), and biceps tendon pathology (1). Thirteen patients had isolated decompression of the nerve to the teres minor. Nine patients had additional procedures performed concurrently including arthroscopic debridement (5), arthroscopic rotator cuff repair (5), subacromial decompression (4), biceps tenotomy (2), and anterior capsule release (2).

Diagnosis

Patients treated for idiopathic teres minor fatty atrophy had preoperative clinical, physical exam, and imaging findings as demonstrated in Table 1. The majority of patients had preserved range of motion with 95% (21/22) having active forward elevation greater than 140°, 89% (16/18) with external rotation at their side greater than 40°, and 82% (14/17) with

external rotation at 90° abduction greater than 80°. No patients had a drop-arm sign or Hornblower's sign, but 86% (12/14) were weak with resisted external rotation in Hornblower's position (external rotation at 90° of shoulder abduction).

Nineteen patients had EMG studies available for review prior to surgery. Eighty-nine percent of these patients (17/19) demonstrated chronic denervation changes in the teres minor. Two patients did not have EMG findings in the teres minor or nerve to the teres minor. Both of these patients had isolated teres minor atrophy on both MRI and US. All patients (19/19) had normal deltoid recruitment on EMG. Ninety-five percent of patients (18/19) had evidence of fatty atrophy on MRI. Only one patient did not show evidence of fatty degeneration on MRI or US, but had evidence of denervation of the nerve to the teres minor on EMG. Utilizing Goutallier classification of fatty degeneration on MRI, the majority of patients grade one or two changes (81% 13/16); 13% (2/16) had grade three or four changes. Figures 3 shows representative pictures from imaging studies.

Surgical Outcome

Following surgery, patient rated outcomes measures improved; see table 2. VAS pain scores decreased an average of four points ($p<0.001$), and ranged from zero to eight-point decrease. No patients had increased pain scores following surgery. ASES scores increased on average 31.7 ± 20.2 points ($p<0.001$) (range -1.3 to 66.7) and SST scores increased an average of 3.1 ± 2.3 points ($p<0.001$) (range -1 to 8).

Given that primary outcomes measured in this study were obtained via telephone interview, post-operative physical exam findings were not available on all patients. For post-operative changes in physical exam findings, see table 3. Most significantly all patients who had weakness with Hornblower's test on preoperative testing had normal strength following decompression of the nerve to the teres minor ($p<0.01$). Forward elevation had a statistically significant improvement ($p<0.01$); however, average preoperative forward elevation deficit was minor or absent and a less than 10° improvement in forward elevation is not clinically significant.

Complications

Two patients developed adhesive capsulitis post operatively. One in a patient with an isolated decompression and resolved after two intra-articular injections and therapy. The other occurred in a patient who had concurrent glenohumeral debridement and required arthroscopic rotator interval release seven months post op. There were no other complications.

Discussion

Previous studies have demonstrated isolated teres minor atrophy on imaging studies in the absence of true quadrilateral space syndrome^{3-5; 11; 12}. These finding possibly suggest a separate clinical entity of isolated teres minor atrophy. It is possible that the majority of patients with isolated teres minor atrophy do not have symptoms related to this pathology. However, the authors have encountered many patients with a clinical presentation suggesting symptoms related to compression of the nerve branches to the teres minor. When

occurring in isolation, these patients present with activity or resting posterior shoulder pain and weakness with external rotation strength in Hornblower's position. The diagnosis is confirmed by the presence of isolated fatty change or atrophy of the teres minor muscle and focal EMG changes.

We believe, given the nonspecific complaint of posterior shoulder pain, that the key to accurately diagnosing this clinical entity is based on soft tissue imaging studies and EMG. Electromyographic findings of chronic denervation consistent with compression were present in 58% (11/19) patients consistent with compression of the nerve to the teres minor by fascial sling as described by Chafik et al³. While 32% (6/19) demonstrated decreased recruitment teres minor muscle without evidence of denervation this may be consistent with the inflexible fascial compartment described by Chafik et al³. Given the inherent difficulties of localizing the teres minor muscle during EMG testing, we have found it more accurate to identify and needle localize the muscle belly with ultrasound guidance. No patients had decreased deltoid recruitment as would be expected with quadrilateral space syndrome. Evidence of isolated teres minor atrophy was evident on MRI (18/19) and US (18/19) in 95% of patients. Both MRI and US were not obtained on all patients due to cost concerns though all patients had at least one imaging study (MRI only: 3, US only: 3, MRI and US: 16). Only one patient of 22 (5%) did not have imaging evidence of teres minor atrophy, but did have evidence of chronic nerve compression on EMG and received pain relief following isolated decompression of the nerve to the teres minor. This suggests that imaging studies may not be able to identify a subset of patients, perhaps because of early detection, but EMG can still be helpful in making the diagnosis. Kallio et al recommended routine EMG evaluation of the teres minor in patients where there is concern for possible compression of the nerve to the teres minor in the absence of teres minor atrophy on MRI.⁹

The primary outcomes measures were subjective patient based validated shoulder scales. In isolated teres minor atrophy, pain is the primary complaint and therefore patient rated outcomes are important to evaluate. In this study, pain relief was consistent, including all subjects with isolated teres minor involvement. Both ASES-scores and SST-scores improved significantly following surgery (31.7 ± 20.2 , $p < 0.001$ and 3.1 ± 2.3 , $p < 0.001$ respectively). This difference also achieved clinical significance given that the Minimal Clinically Important Difference (MCID) in ASES-score has been shown to be 12-17 points and MCID in SST-score as 2 points in patients treated nonoperatively for rotator cuff disease.¹³ All patients had resolution of weakness in Hornblower's position suggesting that their nerve compression was relieved and some neuromuscular recovery occurred. Unfortunately, the majority of subjects had no postoperative imaging or EMG analysis to document the degree of muscle recovery or resolution of nerve compression. Given the significant clinical response to treatment, further evaluation could not be justified.

The primary limitation of this study relates to the retrospective study design. This introduces variability in the methods of preoperative and postoperative evaluation, including imaging and/or EMG studies. Another limitation of the study was patient follow-up; five patients either refused to participate or were unable to be reached for final follow-up. Additionally it was not possible to have all patients return for office follow-up and repeat imaging; this resulted in incomplete post-operative physical exam data and inability to meaningfully

analyze postoperative changes in advanced imaging studies. Finally, this study is limited by heterogeneity of the cohort – a minority of the subjects underwent concomitant procedures for other shoulder pathology in addition to teres minor atrophy. Associated pathology likely confounds the postoperative changes in VAS pain, ASES and SST scores; however, the authors wish to stress that idiopathic nerve to teres minor compression does not necessarily occur in isolation, and the cohort for this study represents true clinical presentations. Though quadrilateral space syndrome is a disputed and controversial entity, we believe that compression of the nerve to the teres minor is a distinct clinical entity with distinct imaging and physical exam findings as well as relief following surgical intervention that warrants further consideration. Given the novelty and rarity of this diagnosis and procedure, we deemed these limitations acceptable although futures studies dedicated to both diagnosis and treatment are indicated.

Conclusions

Idiopathic nerve to teres minor compression is a rare but potentially important clinical entity presenting as activity related posterior shoulder pain, weakness with external rotation in Hornblower's position, combined with isolated fatty degeneration and atrophy of the teres minor and local signs of denervation. In properly selected cases, open release of the fascial sling enveloping the nerve branches to the teres minor can provide relief of symptoms and clinical improvement.

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Figure 1.
Flow diagram of patients in the study

Figure 2.

Surgical approach to decompression of the nerve to the teres minor. (A) Patient positioned in lateral decubitus position with posterior-inferior axillary incision marked. (B) Deltoid is elevated superolaterally and the interval between the teres minor (arrow) and teres major (arrowhead) is identified (C) Teres minor muscle belly (arrow) is noted to have fatty appearance. (D) Fascia overlying the teres minor incised from medial to the quadrilateral space laterally (arrow). (E) Fascia is completely released along the entire course of the nerve to the teres minor (arrow).

Figure 3.
Teres minor atrophy as demonstrated by ultrasound (A), MRI (B)

Table I

Preoperative diagnostic findings

Forward elevation (n=22)	152 ± 9 deg	>140 deg 21/22 (95%)
External rotation at side (n=18)	58 ± 23 deg	>40 deg 16/18 (89%)
External rotation in 90° abduction (n=17)	81 ± 23 deg	>80 deg 14/17 (82%)
Hornblowers' position weakness (n=14)	Very weak	8/14 (57%)
	Weak	4/14 (29%)
	Normal	2/14 (14%)
EMG findings (n=19)	Chronic denervation/ decreased recruitment TM	17/19 (89%)
	Normal EMG	2/19 (11%)
	Normal deltoid recruitment (n=19)	19/19 (100%)
Ultrasound findings (n=19)	Isolated fatty atrophy of TM	n=18 (95%)
	Normal	n=1 (5 %)
MRI Goutallier classification of fatty atrophy in TM (n=16)*	Grade 3	2 (13%)
	Grade 2/1	13 (81%)
	Grade 0	1 (6%)

All range of motion in table represents active range of motion EMG= electromyogram, TM=Teres minor, inc =increased

¹ EMG= electromyogram, TM=Teres minor, inc =increased, deg=Degrees

* Three additional patients had MRI studies with reports of teres minor atrophy, and images unavailable for review.

Table II

Patient outcomes measures

	Pre-op avg±std	Post-op avg±std	Change avg±std	P-value
VAS pain (N=22)	6.2±2.1	2.2±1.9	4±2.4	<0.001
ASES (N=19)	46.6±17.7	78.5±17.7	31.7±20.2	<0.001
SST (N=20)	6.8±2.5	9.9±2.4	3.1±2.3	<0.001

¹ VAS=visual analog scale; ASES=American Shoulder and Elbow Surgeons Shoulder score; SST=Simple Shoulder Test score

Table III

Physical exam findings

	Pre-op	Post-op	P value
Forward elevation (N=15)	152 ± 9 deg	161 ± 8 deg	<0.01
External rotation (N=11)	58 ± 21 deg	62 ± 11 deg	0.64
Hornblower's position weakness (N=7)	86% (6/7)	0% (0/7)	<0.01

¹
deg = Degrees