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Rui Quintino Correia Cardoso

Ruptura maciça da coifa dos rotadores e neuropatia do supraescapular: quando descomprimir? / Massive rotator cuff tears and suprascapular neuropathy: when to do the release?

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Ortopedia e Traumatologia

TÍTULO ~~DISSERTAÇÃO~~/MONOGRAFIA (riscar o que não interessa)

Massive rotator cuff tears and suprascapular neuropathy: when to do the release?

ORIENTADOR

Manuel António Pereira Gutierres

COORIENTADOR (se aplicável)

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É AUTORIZADA A REPRODUÇÃO INTEGRAL DESTE TRABALHO APENAS PARA EFEITOS DE INVESTIGAÇÃO, MEDIANTE DECLARAÇÃO ESCRITA DO INTERESSADO, QUE A TAL SE COMPROMETE.	☐
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À memória do meu pai

Quintino Cardoso

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ABSTRACT

The suprascapular notch is a common location for entrapment of the suprascapular nerve (SN), which is caused by rotator cuff tear (RCT). There is a recent perception of this association due to increased knowledge and more careful evaluation of patients with rotator cuff pathology. Open surgical procedure is the most commonly used treatment for this cause of nerve compression, however, controversy remains whether the SN should be released or not. We analyzed the recent literature related with this theme and selected the most relevant articles (40). Only five of them referred to post-operatory results and we divided them into two groups: one with rotator cuff repair (RCR) with SN release and the other without SN release. Evaluation of the parameters like pain, strength/function, muscle atrophy, fatty infiltration and electromyography (EMG) after surgery showed similar outcomes between the two groups. This comparison allows us to conclude that there is no advantage in releasing the SN when performing a RCR.

RESUMO

A incisura supraescapular é um local comum de aprisionamento do nervo supraescapular (SN) na patologia da ruptura do manguito rotador (RCT). Há uma recente percepção desta associação devido ao aumento do conhecimento e avaliação mais cuidadosa dos pacientes. O procedimento cirúrgico aberto é o tratamento mais comumente usado para esta causa de compressão do nervo, no entanto, a controvérsia permanece se o SN deve ser libertado ou não. Analisamos a literatura recente relacionada com este tema e selecionamos os artigos mais relevantes (40). Apenas cinco deles se referiram aos resultados pós-operatórios, tendo sido divididos em dois grupos: um em que houve reparação do manguito rotador (RCR) com libertação do SN e outro sem libertação do SN. A avaliação dos parâmetros como dor, força/função, atrofia muscular, infiltração gordurosa e eletromiografia (EMG) após a cirurgia, mostrou resultados semelhantes entre os dois grupos. Esta comparação permite concluir que não existe vantagem em libertar o SN quando se realiza a RCR.

KEYWORDS based on Medical Subject Headings (MeSH)

Decompression, Surgical

Electromyography

Humans

Nerve Compression Syndromes

Peripheral Nervous System Diseases

Postoperative Period

Rotator Cuff Injuries

Shoulder Pain

Scapula

Treatment Outcome

PALAVRAS-CHAVE baseado no *Medical Subject Headings* (MeSH)

Descompressão, Cirúrgica

Doença do Sistema Nervoso Periférico

Dor no Ombro

Electromiografia

Escapula

Humanos

Lesão da Coifa dos Rotadores

Período Pós-operatório

Resultado do Tratamento

Síndromes de Compressão Nervosa

INTRODUCTION

The SN originates from the superior trunk of the brachial plexus with contributions mainly from the C5 and C6 nerve roots. It courses laterally through the shoulder deep to the trapezius and omohyoid muscles and then passes through the suprascapular notch beneath the transverse scapular ligament (TSL), while its associated artery and vein travel over the ligament, and enter the supraspinatus fossa (1-17). The nerve continues its course by curving around the lateral border of the scapular spine of the scapula, the spinoglenoid notch, which is covered by the spinoglenoid ligament, to gain entrance to the infraspinatus fossa (1-4, 6, 7, 11, 14, 18-21). SN is responsible for motor innervation of suprascapular muscle (SM) and infrascapular muscle (IM) (9, 12, 14, 15, 21-23) and for up to 70% of the shoulder sensitive innervation (2-4, 8, 9, 19, 21, 22, 24, 25). After passing through the spinoglenoid notch, the SN is purely motor (19).

The pathology of this nerve can be regarded as primary or secondary. Primary compression, which is associated with dynamic causes, presents with muscle wasting of SM or IM, or both, with or without pain, which is typically located at the posterior aspect of the shoulder. This kind of cause responds well to non-operative treatment. Secondary compression, on the other hand, is associated with structural causes like massive RCT. Retraction of a detached SM causes traction on the SN and subsequent tenting of the nerve within the suprascapular notch where it lies beneath the TSL. This kind of cause responds well to operative treatment (8).

Literature from the past decade has provided a prevalence ranging of suprascapular neuropathy (SSN) from 8-100% in patients with massive RCT (4, 26). The recent perception of a higher incidence of SSN and SSN associated with RCT is likely due to increased interest and a more careful clinical evaluation (13, 21).

Patients with SSN, most of whom are aged between 20 and 50 years old, describe an insidious onset of dull, deep and chronic pain, localizing it to the superior, posterior, and lateral aspects of their shoulder, with occasional radiation to their neck or lateral arm that is exacerbated by overhead movement (1-5, 7, 9, 11, 17, 18, 21, 22, 24, 27, 28). The pain and symptoms should be differentiated from cervical nerve root radiculopathy. A localized injection of local anesthetic to the suprascapular notch can be useful to confirm the diagnosis of SN compression (29). An injury at this level could demonstrate weakness with resisted abduction and external rotation of the shoulder, as well as atrophy and fatty infiltration of the SM and IM (22). Pain may precede muscle weakness and atrophy by several years (17).

The gold standard for the diagnosis of SSN and the evaluation of SN function is nerve conduction studies. EMG and nerve conduction velocity (NCV) studies are used to (1) confirm the diagnosis of SSN in the setting of a suggestive history, physical examination and

imaging studies; (2) test nerve function in a patient with SM or IM atrophy, or both, with no identifiable cause; (3) evaluate for neuropathy in a patient without an identified cause of lingering shoulder pain; and (4) monitor nerve function before, during, and after the treatment of any SSN causes (2, 4, 7, 11, 21, 22, 24, 30-32). Although EMG and NCV are the gold standards for diagnosing SSN, a high clinical suspicion in the face of negative test results should then favor the injection for confirmation (22). Clinical differentiation of SSN from RCT may be difficult because both conditions may show considerable atrophy of SM and IM. In such cases, the single most helpful diagnostic study is an EMG, wherein patients with RCT shows no denervation potentials in spinatus muscles because the atrophy represents disuse atrophy (3).

Operative treatment is the most indicated procedure for SSN associated with RCT and it includes two main goals: alleviating the pain (primary indication) and halting the progression of the neural injury, muscle weakness, atrophy and fatty infiltration (12, 17, 22, 32).

To alleviate symptoms after shoulder surgery, there are authors who have recommended RCR with SN release, but there are also others who have shown resolution of SSN with isolated RCR. SN release allows greater mobility of the nerve and mitigates the medializing tendencies of a concomitant massive RCT (17).

The purpose of this study is to define whether SN should be released during RCR when SSN is caused by RCT.

METHODS

A literature review was conducted related to SSN caused by RCT using Pubmed database, on June 12, 2016, using the query “suprascapular neuropathy” and “suprascapular neuropathy AND rotator cuff tear”. The literature search identified 188 and 37 studies, respectively, which were then limited to 40 published based on the following inclusion criteria: (1) information about SSN caused by RCT; (2) pain alleviating methods for RCR during and after surgery. Five studies were selected for comparison in which there were investigated outcome of RCR with SSN caused by RCT with and without SN release. These five studies were separated in two groups: two (Kim et al. (27) and Lafosse et al. (10)) of which the RCT was repaired with SN release, and the remaining three (Mallon et al.(33), Hoellrich et al. (12) and Costouros et al. (34)) where RCT was repaired without SN release. Studies that did not meet the criteria or did not address the purpose of the present review were excluded, as well as studies published in other language than English and before 2000.

RESULTS

The main results are summarized in table 1.

AGE

The population evaluated in these studies is in a range of 41 to 68 years old of mean age.

CLINIC: PAIN

In Kim et al. study, 79% (31/39) of the patients presented preoperatively with mild to moderate pain and postoperatively 100% (31/31) of these patients had pain improvement obtained almost uniformly. 21% (8/39) of the patients had presented preoperatively with persistent severe pain and postoperatively 88% (7/8) of these patients had pain improvement (33).

In Lafosse et al. study, 90% (9/10) of the patients had clinical outcome classified as excellent with complete relief of pain, while 10% (1/10) of the patients had clinical outcome classified as satisfactory with moderate pain improvement. Three patients who were not included in this series had persistent pain postoperatively and each had neurophysiologic evidence of SN entrapment (10).

In Hoellrich et al. study, 100% (9/9) of the patients had pain score significantly improved from a preoperative mean of 2.4 to a postoperative mean of 6.0 (12). In Costouros et al. study, 100% (6/6) of the patients had pain preoperatively and everyone had pain relief postoperatively (34).

STRENGTH / FUNCTION

In Kim et al. study, SM and IM were graded on a strength scale of 0 to 5. 79% (31/39) of the patients who presented Grade 0 to 2 preoperatively in SM and IM strength, postoperatively improved 90% (28/31) in SM strength to Grade 4 or 5; 10% (3/31) with SM strength of Grade 3 improved to 32% (10/31) in IM strength to Grade 4 or 5; 45% (14/31) with IM strength of Grade 2 or 3 and the rest improved to Grade 1. 21% (8/39) of the patients who presented Grade 3 preoperatively in SM and IM strength, postoperatively remained the same or improved 100% (8/8) in SM and IM strength to Grade 4 (27).

In Lafosse et al. study, all patients who had postoperatively significant gain on strength testing, returned to their normal work and sports activity at a mean of three weeks and the abduction and external rotation strength also significantly improved (10).

In Mallon et al. study, all patients had preoperatively severe limitation of active motion, specifically being able to elevate their affected arm actively >40º. The loss of motion and the weakness were their chief complaint rather than pain. Postoperatively, all patients regained

the ability to elevate their arm actively to >90º and to place their hand actively behind their head against gravity without assistance (33).

In Hoellrich et al. study, UCLA shoulder score improved from a preoperative mean of 11 to a postoperative mean of 28. There were 1 excellent, 6 good, 1 fair, and 1 poor results. The poor result was due to a documented failed repair. Function score improved significantly from a preoperative mean of 2.8 to a postoperative mean of 6.8. Less substantial gains were noted in the scores for active forward elevation (3.0 preoperatively and 4.5 postoperatively) and strength of forward elevation (3.1 preoperatively and 3.9 postoperatively) (12).

In Costouros et al. study, all patients had preoperatively marked weakness in abduction and external rotation and postoperatively marked improvement in function. In a strength scale ranging from 0 to 5 (with 5 indicating normal force), SM was graded postoperatively with Grade 4 in 83% (5/6) of the patients and Grade 3 in 17% (1/6) of the patients, while IM was graded postoperatively with Grade 4 in 67% (4/6) of the patients and Grade 5 in 33% (2/6) of the patients. The average flexion improved from 117º preoperatively to 143º postoperatively, external rotation improved from 19º preoperatively to 39º postoperatively and external rotation lag decreased from 28º preoperatively to 4º postoperatively (34).

MUSCLE ATROPHY/ FATTY INFILTRATION

In Lafosse et al. study, Mallon et al. and Costouros et al. studies, all patients persisted with SM and IM atrophy postoperatively (8, 33, 34). In Costouros et al. study, all patients had moderate to severe fatty infiltration and SM and IM atrophy and 83% (5/6) of patients had visible atrophy during inspection. After surgery, all patients had fatty infiltration and SM and persisted IM atrophy (34).

EMG

In Lafosse et al. study, only 80% (8/10) of the patients underwent repeat electromyography to assess SN function postoperatively. At 6 months after surgery, 88% (7/8) of the patients had complete normalization of the conduction velocity, amplitude, and distal latency in the motor fibers of the SN and normalization of the voluntary motor action potential for SM and IM. 12% (1/8) of the patients showed only partial improvement in these parameters (10).

In Mallon et al. study, only 50% (2/4) of the patients underwent repeat EMG postoperatively. At 6 months after surgery, 100% (2/2) of the patients had significant reinnervation potentials with almost complete recovery of the nerve in one case (33).

In Hoellrich et al. study, 100% (9/9) of the patients had postoperatively no EMG evidence of SN injury with normal insertional activity, no denervation potentials, normal recruitment,

and waveform patterns of normal size and configuration (12).

In Costouros et al. study, at 6 months after surgery, patients had partial or full recovery of the SN palsy (34).

PAIN CONTROL DURING SURGERY

In Lafosse et al. study, 60% (6/10) of the patients had interscalene block with general anesthesia and muscle paralysis, while 40% (4/10) of the patients had only interscalene block for anesthesia (10).

In Costouros et al. study, 100% (6/6) of the patients had interscalene block with general anesthesia and intraarticular catheter placed for postoperative pain (34).

DISCUSSION

SSN occurs in majority at the suprascapular notch, which is likely the result of nerve tethering under TSL with RCT. At the spinoglenoid notch, SN compression occurs only in 14% of the cases, which is mostly associated with cysts from labral pathology and is not related with pain since the distal portion of the SN is purely motor, whereas the upper trunk contains motor and sensory fibers (8, 35). There is a huge controversy whether TSL should be released or not when RCR is caused by RCT associated with SSN. There are authors like Kim et al. (27) and Lafosse et al. (10) who support SN release, and others who support the RCR without SN release like Mallon et al.(33), Hoellrich et al. (12) and Costouros et al.(34).

As discussed earlier, SSN in the suprascapular notch is associated with pain, which oftentimes continues after surgery and is so significant that it interferes with the initial recovery and rehabilitation (36, 37). In the studies analyzed, all patients had mild to moderate or even severe preoperative pain and all of them experienced an improvement in pain postoperatively. The same was found related to strength and function scores, where both groups had improvement.

Atrophy was identified in most of the studies analyzed and, in Costouros et al. (34) study, preoperative fatty infiltration was also present, nevertheless, these parameters persisted postoperatively. Oppositely, in another study by Gerber et al., in at least two years, muscular atrophy stopped and was successfully reversed in RCR, whereas atrophy increased after an unsuccessful repair (36). Our research is not concordant with these findings, because in the studies where muscular atrophy was evaluated, it persisted even after the repair. Regarding fatty infiltration, Gerber et al. showed that it cannot be reversed and it has a role in the progression of the tears or failure of the repair. These findings are correlated with tendon quality and functional outcome following surgical repair (36).

EMG abnormalities that conducted to surgery improved at 6 months post-op in all studies analyzed. The key difficulty in the comparison of studies is related to the uncertainties of EMG diagnosis. No previous paper has clearly defined the diagnostic EMG criteria for SSN (34).

In another study, however, Lafosse et al. described the indications for SN release which include: 1) patients who present with weakness of infraspinatus with or without wasting of supraspinatus, with or without pain, with or without positive EMG findings; 2) patients who have a thickened or ossified ligament on assessment during arthroscopic RCR; and 3) patients who present with posterior shoulder pain with a positive SSN Test. So, when compression is suspected, these authors defend nerve release regardless of EMG findings for two reasons: 1) SN pathology is a dynamic phenomenon not always demonstrable on EMG, although in our analysis, all patients had electromyographic changes; and 2) release of the SN is a safe and

simple technique with little risk of additional complications and possible benefit of muscle improvement function post repair (8). Nevertheless, in our study the outcome is similar, so there are no advantages in adding more intervention. This is confirmed by the group where SN release was performed and no muscle atrophy improvement was found.

We also analyzed other parameters that could influence the outcome, like the mean age of patients who participated. The mean age ranged from 41 to 68 years old. Treating people of advanced age has different priorities when compared with young people. The goal in the first group is to transform a symptomatic tear to an asymptomatic one, oppositely, young people look for better function, including muscle strength (38). The rotator cuff undergoes progressive degenerative changes with increasing age, which may lead to extensive RCT (36). In this way, there is a lack of studies with younger patients to understand if there are also similar results in both groups of repair with or without release of the SN.

Other parameter that could influence the results is the extension of the tear. However, we did not take that into consideration because in most cases there is no reference on the classification used, which can cause variability in the analysis.

There are other possible approaches to diminish postoperative pain. Interscalene block is recognized as the most effective approach in general. Its success rate is reported to be 85% to 92% by expert anesthesiologists (39). The major limitation of administering a single injection is that the anesthetic usually has a short duration of action (37) and has possible substantial complications associated with its use, such as peripheral neurologic injuries, central nervous system, respiratory and cardiovascular complications (40). In our analysis, there was no difference between the patients who received pain-controlling methods like interscalene block during surgery and the patients who have not. Although recently, several authors have recommended the continuous use of interscalene block as the gold standard for most shoulder procedures (37).

Our analyses showed that there are no differences between the studies where patients had RCR with SN release (Kim et al. (35)and Lafosse et al.(10)) and the ones where patients had RCR without SN release (Mallon et al.(33); Hoellrich et al.(12) and Costouros et al. (34)).

CONCLUSION

We conclude that there is no difference in terms of pain control, strength, muscle atrophy, fatty infiltration and EMG alterations in RCR with or without SN release. Thus, we believe that there are no advantages in adding an extra procedure when performing RCR.

CONFLIT OF INTERESTS

The authors declare no conflicts of interests.

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Table 1: Summary of the data regarding the results of SSN associated with RCT:						
WITH SN RELEASE						
Study	Study Type	Surgery Type	Mean Age (Years	Number of Patients	Previous nonoperative treatment	Pain control during surgery
Kim et al. (27)	Retrospective	Open release surgery	41	39 of 42	No	No
Lafosse et al. (10)	Prospective case series	Arthroscopy release	50.4	10	Yes: -With physiotherapy and 1 had subacromial injection. -Failed.	-60% of the patients had interscalene block with general anesthesia and muscle paralysis. 40% of the patients had only interscalene block for anesthesia.
WITHOUT SN RELEASE						
Mallon et al. (33)	Prospective case series	Mini-open surgery with partial repair	68	4 of 8	No	No
Hoellrich et al. (12)	Prospective case series	Open surgery	67	9	No	No
Costouros et al. (34)	Prospective case series	Arthroscopy with partial or complete repair	57	6 of 26	Yes: -With physiotherapy, anti-inflammatory medication and subacromial injection. -For a minimum of 3 months. -Failed.	-100% of the patients had interscalene block with general anesthesia and intraarticular catheter placed for postoperative pain.

Table 1: (Continued) WITH SN RELEASE				
Study	Clinic after surgery			Postoperative EMG (at 6 months after surgery)
	Pain	Strength/Function	Muscle Atrophy/ Fatty Infiltration	
Kim et al. (27)	-100% of the patients, who had mild to moderate pain, had improvement of pain. -88% of the patients, who had severe pain, had improvement of pain.	-Patients with Grade 0 to 2 preoperatively: • SM: 90% improved to Grade 4 or 5; 10% improved to Grade 3. • IM: 32% improved to Grade 4 or 5. 45% improved to Grade 2 or 3. 23% improved to Grade 1. -Patients with Grade 3 preoperatively: • 100% remained the same or improved to Grade 4.		
LaFosse et al. (10)	-90% of the patients had excellent improvement of pain. -10% of the patients had moderate improvement of pain.	-100% of the patients had: • Significant gain on strength testing. • Returned to their normal work and sports activity at a mean of three weeks. • Abduction and external rotation strength also significantly improved.	-100% of the patients persisted with SM and IM atrophy.	-88% of the patients had complete normalization of the conduction velocity, amplitude, distal latency in the motor fibers of the SN and normalization of the voluntary motor action potential for SM and IM. - 12% of the patients showed only partial improvement in these parameters.
WITHOUT SN RELEASE				
Mallon et al. (33)		-100% of the patients regained ability to elevate their arm actively >90° and to place their hand actively behind their head against gravity (surgery goals).	-100% of the patients persisted with SM and IM atrophy.	-100% of the patients had significant reinnervation potentials with almost complete recovery of the nerve in one case.
Hoellrich et al. (12)	-100% of the patients had pain score significantly improved from a preoperative mean of 2.4 to a postoperative mean of 6.0.	-UCLA shoulder score improved from a preoperative mean of 11 to a postoperative mean of 28. -Function score improved significantly a mean of 4. -Active forward elevation score improved 1.5 and strength of forward elevation score 0.8.		-100% of the patients had no EMG evidence of SN injury with normal insertional activity, no denervation potentials, normal recruitment, and waveform patterns of normal size and configuration.
Costouros. (34)	-100% of the patients had pain improvement.	- 100% of the patients had marked improvement in abduction and external rotation. - Strength scores: • SM: 83% of the patients improved to Grade 4 and 17% to Grade 3. • IM: 67% of the patients improved to Grade 4 and 33% to Grade 5. -The average flexion improved 26°, external rotation improved 20° and external rotation lag decreased 24°.	- 100% of the patients persisted with moderate to severe fatty infiltration and SM and IM atrophy.	-100% of the patients had partial or full recovery of the SN palsy.

AGRADECIMENTOS

Começo por agradecer ao Professor Doutor Manuel António Pereira Gutierres pela confiança que em mim depositou ao aceitar orientar a minha tese de mestrado. Espero continuar a contar com a sua experiência e orientação em projetos futuros que visem a especialidade que pretendo seguir, Ortopedia.

À família, não há palavras para descrever a importância que a estabilidade desse porto seguro significa. Acredito cada vez mais que somos aquilo que nos permitiram e estimularam a ser. Assim, agradeço por me darem a possibilidade de sonhar, a força que às vezes preciso para arriscar, e a tranquilidade de aceitarem quem sou. Sendo meu, este trabalho é também vosso!

Sendo esta tese de mestrado um dos símbolos de conclusão do percurso académico, enquanto estudante de medicina, aproveito para agradecer a todos os que rechearam este caminho de bons momentos, quer a nível intelectual, quer a nível afetivo.

ANEXOS

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Abstract and keywords: Abstract and keywords in Portuguese and English, with a maximum of 250 words. In original articles, the abstract should be structured, emphasizing the most significant data from the study (Objective: state why study was conducted, emphasizing the motivation; Materials and Methods: succinctly describe the material evaluated and the method used to do so; Results: describe the important findings with statistical data and the respective significance; Conclusions: only report the main conclusions; Descriptors: also known as Keywords – consult the list at BIREME: www.bireme.com.br). For Case Reports, Review Articles, Updating Articles and Preliminary Notes, the abstract does not need to be structured but keywords are required. Below the abstract, specify a minimum of three and a maximum of ten keywords that define the subject of the study. The descriptors or keywords should be based on the Health Science Descriptors (Descritores em Ciências da Saúde, DECS), which are available at the electronic address http://www.decs.bvs.br; or on the Medical Subject Headings (MeSH), from www.nlm.nigh.gov/mesh/MBrowser.html.

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Articles in journals:

1) Borges JLP, Milani C, Kuwajima SS, Laredo Filho J. Tratamento da luxação congênita de quadril com suspensório de Pavlik e monitorização ultra-sonográfica. Rev Bras Ortop. 2002;37(1/2):5-12.

2) Bridwell KH, Anderson PA , Boden SD , Vaccaro AR , Wang JC. What's new in spine surgery. J Bone Joint Surg Am. 2005;87(8):1892-901.
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Chapters in books: Johnson KA. Posterior tibial tendon . In: Baxter D. The foot and ankle in sport. St Louis: Mosby; 1995. p. 43-51.

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