

From the Clinic for Orthopaedics and Traumatology, University of Helsinki.  
(Head: Professor K. E. Kallio.)

## EFFECT OF SCALENOTOMY IN THE SO-CALLED SCALENUS ANTICUS SYNDROME

By

ERKKI KALLIO and PENTTI ROKKANEN

Undoubtedly the Scalenus Anticus Syndrome is a rather confusing term. It is used for a variety of conditions where the main symptoms are neurovascular disturbances in the upper limb. These can be due mainly, or partly and secondarily to pressure effect of the scalenus anterior muscle. The terms cervical rib or costoclavicular syndrome and even brachialgia are used in this connection. They only show the multiplicity of factors involved. One thing seems to be common to all these conditions. Namely that the main symptoms, pain, paresthesia and muscular weakness, can be cured or markedly relieved by the simple operation of scalenotomy.

The purpose of the present investigation is to show the results obtained by scalenotomy in cases where the perplexing condition of the so-called scalenus anticus syndrome was diagnosed or strongly suspected. Two clinical follow-up studies have been published in Finland on this subject (*Ahonen* and *Gylling*).

### *Own Material and the Follow-Up Results:*

The present series consists of all the cases where scalenotomy was performed at the Orthopaedic University Clinic during the years 1951-63. The total material is 64 cases. The age and sex distribution of the cases will be seen in Table 1.

Eight patients are known to be dead, but we have had good information from three of them. Eight patients did not answer the questionnaire. The total material available for follow-up study is therefore 51 cases. The length of the observation period is described in Table 2.

This material was divided into four different groups. The first group "excellent" consists of those patients who stated that their symptoms

were immediately cured by the operation and that the result was permanent. The second group of patients "good" stated that the operation relieved their symptoms markedly immediately and that their condition is much better now than before the operation. The third group of patients "fair" claimed that the operation was worth while and that they got some benefit from it. The fourth group "poor" contains all the patients who stated that the operation was of no value to them. No-one claimed that the operation had aggravated their symptoms, or reported any other ill effects from the operation.

TABLE 1

Age	Female	Male	Total
70-79	-	1	1
60-69	3	3	6
50-59	10	14	24
40-49	10	10	20
30-39	5	4	9
20-29	2	2	4
	30	34	64

TABLE 2

Follow-up period over 9 years .....	7 cases
7-9 years .....	3 cases
5-7 years .....	9 cases
3-5 years .....	10 cases
1-3 years .....	20 cases
Under 1 year .....	2 cases
	51 cases

The follow-up study shows that 35 patients out of 51, that is about 69 per cent, were cured or definitely improved by the small operation.

What has the exact diagnosis been in these cases? One may say that in those cases where the condition did not improve the diagnosis had not been scalenus anticus syndrome. In cases where the condition was practically cured, immediately and permanently, the scalenus anticus muscle certainly had something to do with symptoms. Nearly all of the patients in the "excellent" group expressed spontaneously their sincere gratitude to the surgeon. They pointed out that the conservative treatment had been of no value and that the operation produced immediate relief. The results are described in Table 3.

TABLE 3  
*The Results.*

Excellent .....	21 cases
Good .....	14 cases
Fair .....	5 cases
Poor .....	- 11 cases
	51 cases

In the X-ray pictures we did not find any cervical ribs and only one hypertrophic costal process of the seventh cervical vertebra. In only 10 per cent of the cases were no degenerative changes to be seen in the cervical spine. The main complaint had been pain in the upper extremity. The pain radiated often to the fingers and the hand was weak.

The objective findings at the clinical examination were in the following order of frequency: tenderness to palpation at the supraclavicular region, especially at the site of the scalenus anterior muscle; weakness in the grip and squeezing power of the hand; dropping of the shoulder at the side of the affection and sensory changes in the hand.

Particularly in the "excellent" group the patients could often find some position in the upper limb where the symptoms were relieved. Carrying heavy objects always aggravated the pain. There was no stiffness in the neck or restriction of movement in the upper limbs. In the second group "good", the symptoms were mostly similar to those in the first group, but the hand was often sensitive to cold and many patients had observed stiffness in the neck. In the third group "fair", stiffness in the neck and restriction of the movements of the cervical spine were marked. The pain was particularly severe at night in all of these three groups and the patients often had to stand up and take pills. These symptoms were probably due to cervical spondylosis and disc degeneration. In the fourth group "poor", although many of the symptoms and signs were similar to those in the other groups two important things were different—the position of the involved extremity did not affect the pain or other symptoms and the symptoms were not particularly disturbing at night.

The duration of the symptoms had varied from three months to several years. The length of the duration of the symptoms did not correspond to the result of the operation.

Our results are very similar to those of *Ahonen* and *Karlén*. Scaleno-tomy seems to be a beneficial minor surgical procedure in many cases of cervico-brachial pain. The pre-operative diagnosis of the scalenus

anticus syndrome is often impossible. If neoplasms and infections can be ruled out and conservative therapy has failed, the possibility of scalenotomy should be kept in mind. A careful clinical study and routine X-ray examination of the cervical spine and thorax should be made in every case.

#### DISCUSSION

The scalenus anticus syndrome is described as a more or less definite condition in certain text-books (*Campbell, Finneson, Lange, Mercer*). Some writers prefer other terms, such as costo-cervical syndrome, pressure at the cervico-brachial junction, etc., (*Brain, McGregor, Telford & Mottershead, Wiles*). *Kopell & Thompson* state that there are two scalenus syndromes, the scalenus anticus syndrome primarily with vascular disturbances, and the scalenus medius syndrome primarily concerned with neurological symptoms.

Many anatomical structures have been claimed to be the cause of pressure in this condition: cervical rib, an excessively large costal process of the seventh cervical vertebra—a strong tight fibrous band from a rudimentary rib, which is coming from a cervical or from the first thoracic incomplete rib—and pressure due to abnormal disposition of the scalenae muscles. Many clinical conditions should be taken into consideration when a differential diagnosis is made. Cervical root compression due to disc prolapse, spondylosis and root sleeve fibrosis present a differential diagnostic entity (*af Björkesten*). Incorrect diagnosis is often made because all the mechanisms of referred pain are not well known (*Howard*). *Kopell & Thompson* state that the scalenus anticus syndrome is more often vascular than neurological.

Our experience is in accordance with this. We believe that the immediate favourable result, where the power of the hand has increased so quickly, cannot be explained on a neurological basis, but can be explained on a vascular basis. The main feature in successful cases was that the effect was immediate, both to subjective and to objective examination.

The indication for scalenotomy in the present material has been the so-called scalenus anticus syndrome. By this we mean that the cases selected for operation were chosen on the grounds that the scalenus anticus muscle played a part in the production of symptoms (*Kallio*). It was impossible to come to a definite positive diagnosis pre-operatively, or even post-operatively, in many of the cases.

## SUMMARY AND CONCLUSIONS

The authors report the follow-up examination of 64 cases of scalenotomy performed at the Orthopaedic clinic of the Helsinki University during the period 1951-63. The indication for operation had been failure of conservative treatment and strong suspicion that the scalenus anticus muscle was responsible for most of the neuro-vascular symptoms from the upper limb. In most of the cases presented it was not possible to come to a definite diagnosis. Follow-up examination showed that in the 51 cases which were available for study 21 were cured and 14 obtained marked relief of their symptoms. 5 further patients stated that the operation was worth while and only 11 of the 51 cases were failures. In positive cases the relief was immediate and permanent. This was regarded as mostly due to vascular symptoms. The follow-up period varied from a few months to over 12 years. The pre-operative duration of the symptoms was from three months to several years. There were no cases of cervical rib. The main symptom in successful cases had been complaints of persisting pain extending into the upper extremity. The position of the involved extremity had usually an effect on the pain, so that the patient could find a position where the pain was less and another where it became worse. Carrying heavy objects particularly aggravated the symptoms. The gripping and squeezing power of the affected hand was weakened. The shoulder on the affected side was considered to be lower in most of the cases and there was definite tenderness to palpation over the region of the scalenus anticus muscle. Occupation, age, sex, and the amount of degenerative changes in the X-rays of the cervical spine did not correspond with the result. The authors consider that although the scalenus anticus muscle often played a secondary part in the pathology of production of the symptoms, its cutting relieved the symptoms remarkably often. If conservative therapy has failed and clinical and radiological examination exclude neoplasms and infections, etc., the operation of scalenotomy is worth remembering as a possible method of treatment. A surprisingly large number of patients were very grateful for this operation, as could clearly be seen from the remarks made in the follow-up questionnaire. Although we admit that the positive definite diagnosis of scalenus anticus syndrome is often impossible there can still be justification for scalenotomy. In none of our cases did the condition become worse after the operation. If the indications for scalenotomy are kept very strict many patients remain without relief.

## RESUME

Les auteurs rendent compte de l'observation de 64 cas de scalénotomie, pratiquée à la Clinique Orthopédique de l'Université d'Helsinki pendant la période 1951-63. L'indication de l'opération avait été le résultat inopérant du traitement conservateur et le fort soupçon que le scalène antérieur était responsable de la plus grande partie des symptômes neuro-vasculaires constatés dans les extrémités supérieures. Dans la plupart des cas présentés, il n'avait pas été possible de poser un diagnostic définitif. L'examen complémentaire révéla que sur les 51 cas qu'il a été possible d'étudier, 21 étaient guéris et 14 avaient été essentiellement soulagés de leurs symptômes. 5 autres malades déclarèrent qu'il avait valu la peine de pratiquer l'opération. Dans 11 cas seulement, sur cas 51, l'opération n'avait pas réussi. Dans les cas positifs, le soulagement fut immédiat et permanent, principalement par rapport aux symptômes vasculaires. La période d'observation a varié entre quelques mois et plus de 12 ans. La durée des symptômes pré-opératoires avait varié entre trois mois et plusieurs années. Il n'y avait pas de cas de côte cervicale. Le principal symptôme dans les cas qui ont été opérés avec succès était la plainte d'une douleur persistante s'étendant à l'extrémité supérieure. La position du membre avait généralement un effet sur la douleur. La malade pouvait ainsi trouver une position où la douleur était moindre et une autre où elle était pire. Le port d'objets lourds, en particulier, aggravait les symptômes. Le pouvoir d'étreinte et de pression de la main malade se trouvait affaibli. Du côté malade, l'épaule était apparemment plus basse dans la plupart des cas et il y avait une sensibilité déterminée à la palpation dans la région du muscle scalène antérieur. L'occupation, l'âge, le sexe et le nombre des modifications de dégénération de la colonne cervicale constatés aux rayons X ne correspondaient pas aux résultats. Les auteurs considèrent que bien que le scalène antérieur ne joue souvent qu'un rôle secondaire dans la pathologie qui produit les symptômes, sa section soulage des symptômes extrêmement fréquemment. Si la thérapie conservatrice n'a pas réussi et que l'examen clinique et radiologique exclut la présence de néoplasmes, d'infections, etc. il est bon de songer à la scalénotomie comme une méthode possible de traitement. Un nombre étonnamment élevé de malades a été très reconnaissant de cette opération, ce qui est clairement apparu des remarques portées sur le questionnaire rempli à l'occasion de l'examen complémentaire. Bien que nous admettions qu'il est souvent impossible de poser le diagnostic définitif

d'un syndrome du scalène antérieur, la scalénotomie peut néanmoins être justifiée. Dans aucun de nos cas l'état n'a empiré après l'opération. Si les indications de la scalénotomie sont maintenues très strictes, beaucoup de malades n'obtiendront pas de soulagement à leurs douleurs.

#### ZUSAMMENFASSUNG UND SCHLUSSFOLGERUNGEN

Die Verfasser berichten über die Nachuntersuchung von 64 Fällen von Scalenotomie, die an der orthopedischen Klinik der Universität von Helsinki während der Zeit von 1951–63 ausgeführt wurden. Die Operationsanzeige war das Versagen der konservativen Behandlung und der starke Verdacht, dass der *m. scalenus anticus* für den grössten Teil der neuro-vaskulären Symptome der oberen Gliedmasse verantwortlich war. In den meisten der vorgestellten Fälle war es nicht möglich zu einer bestimmten Diagnose zu gelangen. Die Nachuntersuchung zeigte, dass von den 51 Fällen, die untersucht werden konnten, 21 geheilt waren, während 15 eine bedeutende Erleichterung ihrer Symptome darboten. 5 weitere Patienten erklärten, dass die Operation der Mühe wert war und nur 11 der 51 Fälle schlugen fehl. In positiven Fällen war die Erleichterung unmittelbar und dauernd. Dies wurde angenommen, war meist vaskulären Symptomen zuzuschreiben. Die Zeit der Nachuntersuchung variierte von einigen Monaten bis zu 12 Jahren, die präoperative Dauer der Symptome von 3 Monaten bis zu einigen Jahren. Fälle von Halsrippen wurden nicht gefunden. Das Hauptsymptom in den erfolgreichen Fällen war Klagen über beständige Schmerzen, die in den Arm ausstrahlten. Die Stellung der betroffenen Gliedmasse hatte in der Regel eine Wirkung auf die Schmerzen, so dass der Patient eine Stellung finden konnte, in der Schmerz geringer und eine andere in der er mehr ausgesprochen war. Das Tragen von schweren Gegenständen verstärkte die Symptome besonders. Der Griff und die Druckkraft der befallenen Hand war geschwächt. Die Schulter der ergriffenen Seite wurde in den meisten Fällen als tieferstehend angesehen und eine sichere Druckempfindlichkeit in der Gegend des *m. scalenus anticus* war vorhanden. Beschäftigung, Alter, Geschlecht und die Grösse der degenerativen Veränderungen der Halswirbelsäule im Röntgenbilde entsprachen nicht dem Ergebnis. Die Verfasser sind der Ansicht, dass obwohl der *m. scalenus anticus* oft eine sekundäre Rolle bei dem Entstehen der pathologischen Symptome spielte, seine Durchschneidung doch in bemerkenswerter Weise oft zur Erleichterung der Symptome führte. Wenn die konservative Behandlung ergebnislos war

und die klinische und röntgenologische Untersuchung Neoplasmen und Infektionen etc. ausschliesst, dann ist der Gedanke an die Operation der Scalenotomie als eine mögliche Behandlungsmethode wertvoll. Eine erstaunlich grosse Anzahl von Patienten war sehr dankbar für diese Operation, wie aus den Bemerkungen auf den Fragebogen klar ersichtlich war. Obwohl wir zugeben, dass eine sichere, positive Diagnose des Scalenus anticus Syndromes oft unmöglich ist, kann die Scalenotomie doch berechtigt sein. In keinem unserer Fälle trat eine Verschlechterung des Zustandes nach der Operation auf. Wenn die Anzeigen für die Scalenotomie sehr streng gehalten werden, verbleiben viele Patienten ohne Erleichterung ihrer Beschwerden.

## REFERENCES

- Ahonen, E.*: The Scalenus Anticus Syndrome and the Results of its Operative Treatment. *Ann. Chir. Gynaec. Fenn.* 51: 211, 1962.
- af Björkestén, G.*: Om brachialgier. *Finska LäkSällsk. Handl.* 95: 131, 1952.
- Brain, W. R.*: Diseases of the Nervous System. Oxford University Press, London 1962.
- Campbell's Operative Orthopaedics*. Vol. 2. C. V. Mosby, Saint Louis 1963.
- Finneson, B. E.*: Diagnosis and Management of Pain Syndromes. W. B. Saunders, Philadelphia 1962.
- Gylling, M.*: On the Scalenus Syndrome. *Acta chir. Scandinav.* 102: 475, 1952.
- Howard, L. G.*: Neck and Shoulder Pain Syndromes. *Med. Clin. N. Amer.* 36: 1289, 1952.
- Kallio, K. E.*: Personal communication.
- Karlén, A.*: A propos de la scalénotomie. *Acta orthop. Scandinav.* 18: 203, 1948.
- Kopell, H. P. & Thompson, W. A. L.*: Peripheral Entrapment Neuropathies. Williams & Wilkins, Baltimore 1963.
- Lange, M.*: Orthopädisch-Chirurgische Operationslehre. J. F. Bergmann, München 1962.
- McGregor, A. L.*: A Synopsis of Surgical Anatomy. J. Wright, Bristol 1957.
- Mercer, W.*: Orthopaedic Surgery. E. Arnold, London 1959.
- Telford, E. D. & Mottershead, S.*: Pressure at the Cervico-Brachial Junction. An Operative and Anatomical Study. *J. Bone Jt Surg.* 30 B: 249, 1948.
- Wiles, Ph.*: Essentials of Orthopaedics. J. & A. Churchill, London 1959.