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Bipolar release in congenital muscular torticollis: does attachments of sternocleidomastoid matter?

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Introduction：We studied the influence of distal sternocleidomastoid attachments - sternal or clavicular, on outcome of bipolar surgical release in congenital muscular torticollis (CMT) in pediatric age group.

Material and methods：Sixteen patients with CMT operated over a span of 7 years were reviewed retrospectively. The patients were categorized using the illustrated test, according to head of sternocleidomastoid muscle involved - mainly sternal; mainly clavicular; both heads. All patients underwent a uniform surgical procedure (bipolar release). At follow up, the result were evaluated by modified Lee's score. Gaze angles (GA) were used for the assessment of facial asymmetry.

Results：Mean age at surgery was 6.93 ± 1.73 years. Sternal, clavicular and both head involvement was seen in 7, 4 and 5 patients respectively. The mean follow up after bipolar release was 5.15 ± 2.45 years.

The mean Lee score in sternal, clavicular and both heads group was 13 ± 3.50, 12.75 ± 2.5 and 12 ± 1.41 respectively (p=0.615; statistically insignificant). The mean GA in sternal, clavicular and both heads group was 83.43 ± 3.50, 86.25 ± 2.22 and 86.4 ± 1.67 degrees respectively (p=0.153; statistically insignificant).

Conclusions：A clinical test to differentiate SCM head involvement is described. Bipolar release addresses the deformity of CMT irrespective of the heads of sternocleidomastoid muscle.

Introduction

Congenital muscular torticollis (CMT) results from fibromatosis and contracture of the sternocleidomastoid muscle (SCM) causing the head to tilt towards the affected side and chin to the opposite side[7)9)13)].

In low income countries with less awareness, patients usually present late with cosmesis being the primary concern[13)]. Various surgical techniques for treatment of CMT include subcutaneous/open/endoscopic tenotomies which may be unipolar or bipolar[4)～6)9)11)12)15)], resection of contracted sternocleidomastoid portion[14)] or its Z

Key words：congenital muscular torticollis, sternocleidomastoid muscle, child, bipolar release
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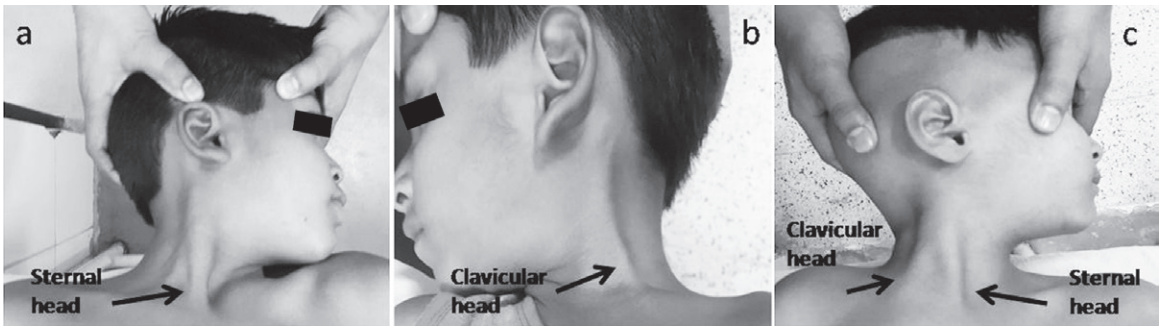

Fig. 1. The polarity test to see the head of SCM involved : a, mainly sternal head b, mainly clavicular head c, both heads involved.

plasty[9]. In bipolar release, a technique described by Ferkel et al, both proximal and distal attachments of sternocleidomastoid are released[2]. The procedure has virtue of both correction and preserved cosmesis. Several authors have reported satisfactory outcome in CMT following this procedure[9)7)13)].

The severity of CMT can vary with involvement of either or both SCM distal attachments - clavicular and sternal[5]. The role of the particular segment of SCM, sternal or clavicular or both, in CMT has neither been talked about in the literature nor there is published literature regarding the outcome of surgical release comparing the attachments of SCM. We therefore envisaged a study to see the influence of attachments on the results of bipolar release of SCM in the long term.

Material and methods

Between 2009 to 2015, 16 patients with CMT who were treated at our institute were analysed retrospectively. Informed written consent from the patients/ and patient's guardians was obtained for publication of results. Pre surgery case records were compared with follow up evaluation for appraisal of various outcomes.

Test to see the head of SCM involved : The patient is placed in supine position with both the shoulders stabilized and head and neck supported by the examiner over the edge of the examination couch in such a way that the head and neck region is free to rotate. The examiner now rotates the head and neck laterally and extends it such that the patient's head hangs over the edge of the examination couch (Fig. 1). The SCM head which is mainly involved becomes more prominent.

The patients were categorised into three groups on the basis of the above mentioned test, according to the head of the SCM muscle involved - mainly sternal (Fig. 1a); mainly clavicular (Fig. 1b); both heads (Fig. 1c). All patients underwent a uniform surgical procedure (bipolar release) done by the senior author (AA).

Operative technique[2] : Three to 4 cm transverse incision was made superior to the clavicle and between the two heads of SCM. After dividing the subcutaneous tissue and platysma in the line of skin incision, the tendon sheaths of the clavicular and sternal heads were exposed. The clavicular head was cut near its insertion and sternal segment 2–3 cm proximal to the insertion. The two cut ends were then approximated to have a common lengthened SCM at its distal attachment. For the proximal pole exposure, a 2 cm horizontal incision was made just distal to the tip of mastoid. The insertion of SCM muscle was exposed anteriorly and posteriorly taking care of adjoining neural structures. The tendon

Table 1. Modified Lee's scoring system for torticollis[8].

Points	Neck movement	Head tilt	Scar	Loss of column	Lateral band
3	Full	None	Fine	None	None
2	<10°	Mild	Slight	Slight	Slight
1	10–25°	Moderate	Moderate	Obvious but cosmetically acceptable	Obvious but cosmetically acceptable
0	>25°	Severe	Unacceptable	Unacceptable	Unacceptable

was then sectioned completely. Both surgical areas were further explored to release any remaining tight bands or fascial structures. Closure in layers was performed after achieving hemostasis.

Post operatively, head halter traction was employed for initial 3 weeks to provide rest to the part, reduce neck spasm and muscle stretching. It was removed intermittently for assisted physiotherapy consisting of muscle stretching, strengthening and range of motion exercises initiated from early postoperative period. A semi rigid foam cervical collar was used beyond 3 weeks when aggressive physiotherapy protocol was followed. The results were evaluated by modified Lee's score12 and Gaze angles (GA)[1] at final follow up.

The modified Lee's scoring system[8] (Table 1), includes function (neck movement) and cosmesis (head tilt, operative scar, loss of column, and lateral band), and divides outcome into four categories: an excellent result has a score of 14–15 points; good 12–13 points; fair 10–11 points; and poor 9 or fewer points. The neck movement, loss of column and lateral band were compared with the uninvolved side, and the head tilt and operative scar were evaluated by clinical observation.

GA was used for the assessment of facial asymmetry[1]. Standard photograph of the patient using point and shoot camera was taken for measurement of GA. A constant subject to lens distance was maintained with a measuring tape. The angle measurement was done by using Measure and Sketch application version 2.8.3 ©. The angle was formed between horizontal axis between the outer canthus of both eyes and a vertical line through the midsternal point (Fig. 2).

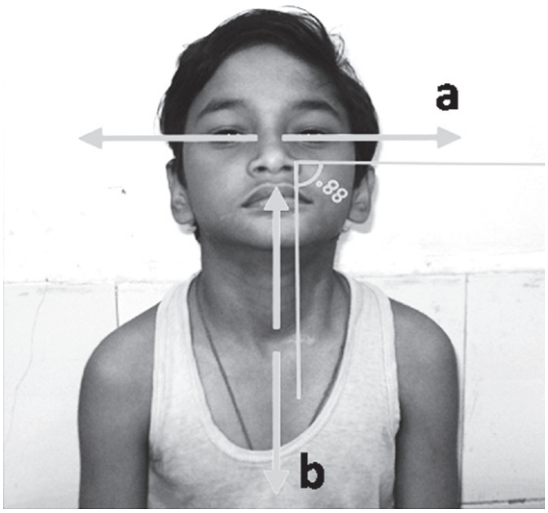

Fig. 2. The angle formed between a and b is the gaze angle (GA). a = horizontal axis between the outer canthus of both eyes and b = vertical line through the midsternal point.

Statistical analysis was performed using the online website www.socscistatistics.com. The statistical significance of modified Lee score and Gaze angle was assessed using one way ANOVA test. A p value <0.05 was considered statistically significant.

Results

There were 10 females and 6 males (n=16). Right side was involved in 9 and left in 7. Mean age at surgery was 6.93 ± 1.73 years. Sternal, cla-

Table 2. Patient details (n=16).

S. no.	Head involved	Side	Age at surgery (in years)	Follow up (in years)	Modified Lee score	Gaze angle (in degrees)
1	STERNAL	L	6	6	13	81
2	STERNAL	L	8	4	14	85
3	STERNAL	L	8	2	13	82
4	STERNAL	R	10	1.5	14	83
5	STERNAL	R	5	4	13	78
6	STERNAL	L	7	7	14	87
7	STERNAL	R	6	8	10	88
8	CLAVICULAR	R	5	5	14	84
9	CLAVICULAR	L	8	4	9	87
10	CLAVICULAR	R	5	8	14	85
11	CLAVICULAR	R	9	6	14	89
12	BOTH	R	5	5	11	86
13	BOTH	R	7	2	13	85
14	BOTH	L	6	7	10	85
15	BOTH	R	10	3	13	87
16	BOTH	L	6	10	13	89

Abbreviations : L – Left; R – Right

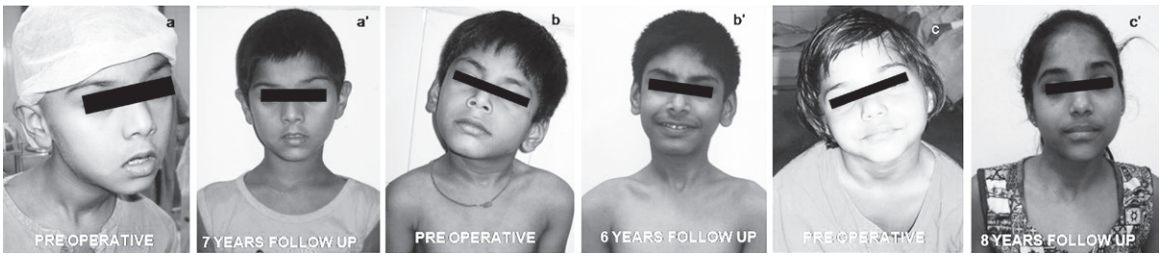

Fig. 3. a, b, c shows preoperative pictures of CMT with mainly sternal head involvement and a', b', c' shows excellent (Score - 14), good (Score - 13) and fair (Score - 10) results respectively as per modified Lee scoring system.

vicular and both head involvement was seen in 7, 4 and 5 patients respectively. The mean follow up after bipolar release at final evaluation was 5.15 ± 2.45 years (Table 2).

The mean modified Lee score in sternal, clavicular and both heads group was 13 ± 3.50, 12.75 ± 2.5 and 12 ± 1.41 respectively (p=0.615; statistically insignificant). In sternal group, excellent results were seen in 3, good in 3 and fair in 1 (Fig. 3). In clavicular group, excellent results were seen in 3 and poor in 1 (Fig. 4). Three patients had good result and 2 fair in both heads group (Fig. 5).

The mean GA in sternal, clavicular and both heads group was 83.43 ± 3.50, 86.25 ± 2.22 and 86.4 ± 1.67 degrees respectively. All patients had gaze angle of more than 80 degrees except for one patient (both heads group). There was no statistically significant difference among the three groups with respect to GA (p=0.153) as well.

Discussion

In children with CMT, bipolar release is an

Fig. 4. a, b shows preoperative pictures of CMT with mainly clavicular head involvement and a', b' shows excellent (Score - 14) and poor (Score - 9) results respectively as per modified Lee scoring system.

Fig. 5. a, b shows preoperative pictures of CMT with both head involvement and a', b' shows good (Score - 13) and fair (Score - 10) results respectively as per modified Lee scoring system (note the hypertrophic scar in a' at site of surgical incision).

accepted and established surgical procedure[3]. However, attachments of SCM has rarely been differentiated in surgical planning or outcomes. We evaluated the function, cosmesis and facial asymmetry following bipolar release in our study taking heads of SCM into consideration.

Sudesh et al1[13] evaluated 14 cases of CMT in whom bipolar release was done. The mean age of patients was 13.4 years (range, 10–19 years) and the mean follow up 3 years (range, 1–5 years). Final assessment in this study was done by modified Lee score. They reported excellent results in 3 patients, good in 7, fair in 2, and poor in remaining 2. In no patient was the surgical scar cosmetically unacceptable. The authors concluded that in CMT bipolar release is an adequate and complication free method.

Gill et al[3] did bipolar release in 10 cases of CMT in children with the mean age 7.5 years. Neck range of motion, recurrence of deformity, residual facial asymmetry and any developing visual errors were assessed at each follow up. Lateral head rotation improved significantly and residual head tilt was seen in only one patient. In 4 cases, facial asymmetry reverted back to almost normal and in remaining 6, some asymmetry persisted. Overall, 9 patients had good results and one fair result.

Patwardhan et al[9] used two scores: modified Lee score and Cheng and Tang score for evaluation of bipolar release with Z lengthening in 12 adult patients. They reported excellent clinical and functional results despite the fact that the mean age in their study was 24 years.

The average age of the patient in our series

was 6.93±1.73 years. For all patients, the bipolar release was performed which is the preferred method for torticollis management for older patients in the literature[3)9)13)]. In our study, the mean modified Lee scores in sternal, clavicular and both heads were statistically similar at mean follow up of 5.15 years. Twelve out of 16 patients had either excellent or good results reconfirming again the fact that satisfactory functional and cosmetic results in CMT can be obtained with bipolar release. One patient of clavicular group had poor result because of significantly decreased neck movements and an obvious subcutaneous lateral band (Fig. 4b'). Our study therefore emphasizes the importance of exploring and cutting of adjoining fascial bands and other contracted structures during the CMT surgery.

Facial asymmetry may occur after prolonged unilateral contracture of SCM[10)]. Atul et al[1)] in their study of 31 patients used GA for the assessment of facial asymmetry after bipolar release. The mean age at presentation for surgery was 8.46 years and the mean follow up 28 months. They classified their patients into 3 groups depending on the severity of CMT. The mean GA in grade 1, 2 and 3 varied from 81.71 to 90, 72.77 to 89.16, and 66.60 to 88, respectively. They concluded that bipolar release works even for severe cases and GA is good method for assessment of facial asymmetry.

In our study of 16 patients, the mean comparative GA in three groups were statistically non significant. This signifies that the three groups behaved in a similar fashion with respect to GA angle following bipolar surgical release. Further, 15 out of 16 patients had GA of more than 80 degrees again indicating satisfactory results can be obtained following the bipolar procedure.

The surgery in CMT has always focussed on release of contracted SCM tendon and restoration of neck cosmesis. We have highlighted a clinical technique to differentiate the tightness of two heads for presurgical planning of CMT (Fig. 1). Firstly, by the test, the surgeon is aware of the more severe attachment and can plan surgical incisions and dissection accordingly. For a negative test, the surgeon should rethink the procedure and workup.

The clinical test described was performed for all patients preoperatively. However, it did not have a bearing on deciding the operative procedure for our series. The test significance was subsequently established from the intraoperative findings. We found that the clinical test did guide to the tight SCM portion preoperatively. In older children, once the tight head of the muscle was released, the masked tightness of other head (fascial bands) became obvious in many patients. Therefore, for older patients, bipolar release which addresses both heads of the SCM is a relatively safer bet. Our study statistics also indicated that bipolar release worked irrespective of the predominant tight SCM head.

Our study had certain limitations. It was a retrospective analysis of surgical results. No pre operative scoring system was used, though due to peculiar conditions prevailing in low income countries, most of the patients do not seek clinician's opinion unless the torticollis deformity is severe. The gaze angle being done manually, inter-rater and intra-rater subjectivity was another consideration[9)]. The sample size of 16 divided into two subgroups limit the patient number in each category and findings observation dependent. The statistical analysis was not very robust for the same reasons. The disease understandably has low incidence and studies with large sample size and long term follow up of bipolar release are quite rare.

We have described a clinical test to differentiate tightness of SCM head. Our study concluded that bipolar release addresses the deformity of CMT well irrespective of the tight attachments of SCM. A future research prospective which arises from this manuscript is that for younger patients where a surgical release is planned, this clinical test may help to reduce dose of surgery and preserve natural cosmesis of SCM. In these patients, the fascial bands and secondary contractures of other head might not have yet established. As such, an 'a la carte' approach starting with unipolar release of tight SCM head may be initiated. The clinical test may be repeated intraoperatively to dictate further quantum of surgical release. This supposition, however requires confirmation from prospective studies.

Conflict of interest：*nil*

Financial conflicts：*nil*

Written consent was obtained from the patients for publishing of figures.

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