

EMG Guided Selective Tibial Neurectomy in Reduction of Gastro-soleus Spasticity - its Role in the Treatment of Cerebral Palsy

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Abstract :

A study to find out effectiveness of EMG guided selective tibial neurectomy in spastic cerebral palsy patients and also to ascertain the optimal age for this surgery was conducted on fifty one patients (M-35, F-16), age ranging from 2 to 8 years, during the period from January 1991 to December 1999. EMG guided selection and neurectomy of the branches of tibial nerve supplying gastrocnemius muscle in the popliteal fossa was performed. Results were graded as good, fair, and poor according to a set of dynamic and static tests. Out of 51 cases, 27(52.94%) were graded as good, 27(23.94%) as fair, 6(11.76%) as poor. There were no major intra-operative and post-operative complications in the series. Optimum age was found to be between 3 to 4 years. EMG guided selective neurectomy of tibial nerve was found effective in relieving gastro-soleus spasticity in 85.88% cases studied, thereby helping to carry out neuro developmental exercises for the treatment of cerebral palsy.

Key words : Cerebral Palsy (CP), Spasticity, Equinus, Gastrocnemius, Tibial neurectomy

Introduction

Spasticity, the commonest manifestation in Cerebral Palsy patients hinders motor development, nursing care, and often leads to contracture formation within the long standing cases. Gastro-soleus spasticity is the primary problem that hampers standing balance and normal gait pattern, which are the major concern of the patients. Conservative management such as exercises, physical therapies, orthoses, and medicines are not generally effective to give a permanent relief.

There are many orthopaedic procedures for reducing gastro-soleus spasticity for a longer duration. They are; a) intra muscular injection of phenol/ alcohol either at the motor point or muscle bulk^{1,2}. b) intra-neural infiltration of phenol/alcohol in the tibial nerve^{1,2}. c) injection of botulinum toxin in gastro-soleus muscle^{3,4}, and d) neurectomy of tibial nerve in the popliteal fossa^{5,6}. The first three procedures are effective in reducing spasticity for a period of weeks to months. Their effect is temporary and their efficacy cannot be ascertained with a degree of certainty. Botulinum toxin is very costly and at present it is out of reach of majority of Indian patients, though this injection also results

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in definite degree of reduction of spasticity. Moreover, neuro-surgical methods, intra-theccal baclofen^{7,8} and selective dorsal rhizotomy^{9,10} are also used to reduce spasticity. These procedures can only be done in advanced centres; hence they are out of reach for majority of our patients. Neurectomy of branches of tibial nerve to gastro-soleus muscles results permanent reduction of spasticity in these muscles.

This study was conducted to find out effectiveness of the EMG guided selective neurectomy of tibial nerve in spastic cerebral palsy patients and also to ascertain the optimal age at which tibial neurectomy should be done.

Materials and Method

Subjects : Study subjects included Cerebral palsy patients, who attended the Department of Physical Medicine and Rehabilitation, Regional Institute of Medical Sciences, Imphal during the period from January, 1991 to December, 1999. There were 513 patients in total; of which 258 were diplegic, 136 were hemiplegic, 59 were quadriplegic, 46 were triplegic and remaining 17 were monoplegics. About 79% of these cases were spastics. Neuro-developmental exercises to improve neck holding, sitting and standing balance, etc. were started depending on their developmental milestones. Passive range of mobilization exercises; reflex inhibitory positions to reduce spasticity were started. Tendo achiles stretching exercises were instituted specially for gastro-soleus spasticity. In those cases in which conservative treatment is not yielding satisfactory result, a trial of injection phenol or alcohol either in the nerve or muscle (alcohol) was given. In 24 cases, Ankle Foot Orthoses were tried to keep ankle and foot in neutral dorsiflexion

Fifty one cases (35 males and 16 females) were selected for selective tibial neurectomy. Age ranged from 2 to 8 years (mean- 3.84). Age distribution is given in Table 1.

Table 1 : Age distribution (N = 51 , M-35, F-16)

<i>Age Group</i>	<i>Number</i>	<i>Percentage</i>
2 - 3	11	21.56
3 - 4	18	35.29
4 - 5	12	23.52
5 - 6	8	15.68
6+	2	3.92

Inclusion criteria for the study were : a) spastic diplegic and hemiplegics who failed to respond to non-operative treatment to reduce spasticity, b) Spasticity grade II and III(modified Ashworth scale), c) presence of ankle clonus, d) presence of sitting balance, e) no structural tightness of tendo-achiles, hamstrings, adductors of hip ,etc. Exclusion criteria were; a) triplegic and quadriplegic patients, b) patients with associated mental retardation, hearing and visual impairment and systemic diseases.

Procedure :After proper antiseptic/aseptic precautions and under a mid thigh pneumatic tourniquet, a horizontal incision 5cm - 7.5cm long was made at the popliteal crease. Gastrocnemius were exposed. The plane between two gastrocnemi was deepened and retracted to expose the tibial nerve, which lies in the superficial plane to the posterior tibial vessels. Tibial nerve was properly isolated from the vessels and was held up with a strip of gauge. Muscular branches to medial and lateral heads of gastrocnemius were identified by using EMG (teflon coated) needle. The effects were seen as visual contractions of the muscles and compound motor action potential (CMAP) in the EMG monitor. The important step was to exclude the sural communicating nerve which also arose from tibial nerve and was a purely sensory nerve. Inadvertent section of this nerve led to painful neuroma at this site.

Usually there were one to two muscular branches for medial and one for lateral gastrocnemius muscle. These nerves were traced

to muscle bellies and sectioned at two points; one at the motor point and the other at 1cm from the first. Wounds were closed in layers. Pressure bandage was applied.

Exercise to re-educate dorsiflexion of ankle and toes were started within one week after surgery or as soon as pain subsided. Further follow-up were done at Six week, 3months, 6months, 12months intervals. Along with tibial neurectomy, release of hamstring tendons were performed in 14 cases with

hamstring spasticity and partial obturator neurectomy was also performed in 12 cases to reduce adductor spasticity leading to scissoring.

Results

The results were graded as 1) Good 2) Fair 3) Poor, according to static and dynamic tests done as follows (Table no.2):

Table - 2 : Results

<i>Tests</i>	<i>Good</i>	<i>Fair</i>	<i>Poor</i>
Static			
1) Passive stretching of ankle into dorsiflexion.	Free	With resistance	Upto neutral
2) Active dorsiflexion of ankle.	Normal	Neutral.	Unable.
3) Squatting - observe the symmetry of limbs.	Normal	Possible with limbs abducted.	Unable
Dynamic			
1) Toe clearance with active dorsiflexion of toes during swing phase.	Normal	Neutral dorsiflexion.	Plantar flexion.
2) Global assessment by the patient's relatives/treating team.	Normal	Fair.	Poor.
Number-51	27(52.94%)	18(32.94%)	6(11.76%)

The regular follow up was done upto 1 year in all cases. Most of the cases were taken up in an age group ranging from 2-4 years, as this is the time for training sitting balance and walking. Along with reduction of gastro-soleus spasticity, other associated spastic/athetoid conditions in the upper limb or other parts of lower limbs were also reduced in 9 cases.

There were no major intra-operative complications in this series like injury to the popliteal vessels. Post-operatively, no calcaneus deformity was observed. Minor complications, like wound dehiscence, stitch infection were observed in 10 cases, which resolved with treatment.

Discussion

The first neurectomy was reported in 1913(Stoffel) and this became a popular method of reducing gastrocnemius spasticity in 1951(Phelps); soleus spasticity in 1952(Eggers)¹³. Use of Botulinum toxin for the treatment of spasticity in cerebral palsy was reported extensively in recent literature. Neville reviewed the role of this method of treatment in cerebral palsy¹⁴ and pointed out many shortcomings in this method. Neurosurgical procedures like selective dorsal rhizotomy, intrathecal Baclofen became very popular treatment for spasticity in cerebral palsy.

Subramanian et. al¹⁵ reviewed cases of selective dorsal rhizotomy (SDR) after 10 years and found that SDR was not useful as expected in all cases. As for intrathecal Baclofen, this is too complicated technology to be practical in our set-up. Orthopaedic procedures like tendo-achilles lengthening, tendon transfer for equines foot were reported by the authors like Steinwender et.al¹⁶, Camacho et.al¹⁷. These were done in older children who had developed fixed equinus deformities. There were a few recent reports of tibial neurectomies either for gastrocnemius and/ or soleus^{18,19}. There were no attempts to find out the suitable age to perform this operation. Bleck⁵ reported the incidence of calcaneus deformity as result of gastrocnemius neurectomy.

We observed that selective tibial neurectomy gives effective and more or less permanent relief of gastrocnemius spasticity in 85.88% of cases. This operative procedure was relatively easy and could be completed in 30 minutes or less. We didn't encounter any major intra operative complication. The component of gastrocnemius spasticity was completely relieved. However, the nerve supply to soleus was left untouched. By this way, we avoided the post operative calcaneus deformity in our series. However, the spasticity due to soleus component may be the cause for our poor and fair results in 44.70% cases. This operation can also be done without EMG guidance. However, with this procedure the chance of crushing the wrong nerve is high. Two cases of painful neuroma were encountered. This procedure should be done as early as possible in around the age of 3-4 years in properly selected cases.

Conclusions

Hence, we concluded that selective tibial neurectomy is a safe, effective and permanent method of reducing gastrocnemius spasticity in Indian context. This should be done as early as possible, at 3 to 4 years age which helps the

functional recovery in terms of the ease of carrying out neuro-development exercises.

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