Total Resection of Gastrocnemius Muscles for Hypertrophic Muscular Calves

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Many Oriental women are bothered by unsightly plump calves. In severe cases, the conditions are ridiculously described as radish-like legs. They usually are unwilling to wear short skirt and pants. They admire long and slender legs of fashion models. In the past, liposuction was frequently performed to treat oversized legs. Unfortunately, little effect could be obtained by liposuction if the conditions were due to hypertrophy of calf muscles. Total gastrocnemius muscles resection for hypertrophic muscular calves were performed in 10 patients at Buddhist Tzu-Chi General Hospital from May 2001 through April 2004. There were two males and eight females. Four cases had previous ineffective liposuction of lower legs. Weight of the resected gastrocnemius muscle ranged from 250 to 430 g per calf (mean, 343 g). Reduction of the circumference of the calves was 3.5 to 6.0 cm (mean, 4.5 cm). All patients could walk and go upstairs or downstairs smoothly within 4 to 6 weeks, and could run and do exercise without difficulty within 3 to 6 months. Seroma developed in one patient and late hematoma in 3 patients postoperatively. One patient had dragging of one foot for 6 months. Although three patients still complained of scar problems during the follow-up period, all patients were rather satisfied with the reduction of their calf sizes. (J Plast Surg Asso R.O.C. 2005;14:91~100)

Key words: hypertrophic muscular calves, radish-like legs, gastrocnemius muscle resection, liposuction, calf reduction

Introduction

Oriental women usually have shorter body height and plumper lower leg than the Caucasian. In severe cases, the legs look radish-like and are conspicuously unsightly. Liposuction was frequently used in stead of calf myectomy for calf reduction in the past, but it was only effective for oversized calves due to thick subcutaneous fatty layer. Liposuction will
be ineffective for hypertrophic muscular calves. In 1998, Lemperle and Exner reported resection of gastrocnemius muscle in disturbing calf hypertrophy. This procedure is still seldom performed, because both the surgeons and the patients concern about functional impairment of legs. We’re going to present a series of ten cases which the above technique being applied.

Materials and Methods

A total of 10 patients with hypertrophic calf muscles were treated at Buddhist Tzu-Chi General Hospital between May 2001 and April 2004. All were treated with resection of gastrocnemius muscle in both legs. Patient age, sex, body height and weight, occupation, previous procedures, preoperative maximal circumference of calves, weight of the resected muscle, clinical outcome and complications were all recorded from retrospective chart review and recall survey. Patient follow-up ranged from 5 months to 40 months, with an average of 13 months.

Anatomy

The muscles in the posterior compartment of the lower leg include superficial and deep groups, separated by deep transverse fascia. Gastrocnemius, plantaris and soleus muscle occupied the superficial group and form the bulk of the calf. Gastrocnemius and plantaris act on both knee and ankle joints, soleus on the latter alone. Gastrocnemius is the most superficial muscle of the posterior leg. It arises by medial and lateral heads, which are connected to the medial and lateral condyles of the femur by strong, flat tendons. The fleshy part of the muscle extends to about midcalf, the muscle fibres of the larger medial head extending lower than those of the lateral head. As the muscle descends, the muscle fibres begin to insert into a broad aponeurosis that develops on its anterior surface. The aponeurosis gradually contracts and receives the tendon of soleus on its deep surface to form the tendo calcaneus or Achilles tendon. The two heads of the gastrocnemius and the soleus muscle are collectively called the triceps surae. These muscles are the chief plantar flexors of the foot, and the gastrocnemius is also a flexor of the knee.

Gastrocnemius propels in walking, running and leaping. Soleus is said to be more concerned with steadying the leg on the foot in standing. This postural role is also suggested by its high content of slow, fatigue-resistant (Type 1) muscle fibres. In man, however, such a rigid separation of functional roles seems unlikely; soleus probably participates in locomotion, and gastrocnemius in posture. The relative contributions of soleus and gastrocnemius to phasic activity of the triceps surae in walking has not been satisfactorily analysed. Several studies on leg function after muscle flap transfer reveal significant impairment after soleus transfer but not after total gastrocnemius transfer.1,3,4,5,6

Operative Procedure

The operative procedure follows Lemperle and Exner’s technique with some modifications. Under endotracheal general anesthesia, the patient is put on prone position. A 5 cm horizontal incision is made over the popliteal fossa on the level of medial and lateral condyle. The fascia cruris is then incised vertically to expose the gastrocnemius muscle and its adjacent neurovascular structures. The two heads of the gastrocnemius muscle are dissected...
in the popliteal fossa to free from the adjacent tissue and looped by Naleton tube separately. Great care is taken not to injury the lateral sural cutaneous nerve and common peroneal nerve overlying the lateral gastrocnemius muscle.

Another 2 cm vertical skin incision is made over the midcalf just above the insertion of the gastrocnemius muscle into the Achilles tendon. Blunt dissections between the two incisions expose the gastrocnemius muscle from the overlying fascia cruris and underlying soleus muscle easily. The insertion of the gastrocnemius muscle into the Achilles tendon is cut sharply and preserves the underlying soleus muscle and the medial sural cutaneous nerve separately.

After pulling upward of both muscle belly, further meticulous dissection is taken around the neurovascular bundles of both heads and toward its origins at the medial and lateral condyles in the popliteal fossa. Identification and careful protection of the motor nerve to the soleus muscle is paramountly important. Then the neurovascular pedicle is ligated and divided, both heads are cut from their origins. The wounds are closed in layers after placement of silicone drains.

Postoperatively, the patient is encouraged to walk on the second day. The drain tubes and the stitches are removed 7 days after surgery. Compressive garment is advised for 3 months. The surgical scars are meticulously cared with adhesive tapes. The clinical outcome and leg function are evaluated monthly.

Results

From May 2001 through April 2004, 10 patients with hypertrophic muscular calves were treated (Table 1). Age of the patients ranged between 24 and 48 years old (mean 33). Two were males and 8 were females. Four patients had previous liposuction of their calves. The maximal circumference of the calves before surgery measured between 33.5 and 41 cm (average, 36 cm). In the first case, only resection of the medial head of gastrocnemius muscle was done. Total resection of gastrocnemius muscle was done in the remaining nine subsequent patients in this series. Weight of the resected muscle ranged from 250 to 430 g (average, 343 g) per calf. Neither skin resection nor liposuction was performed for all the patients. The maximal circumference of the calves measured between 30 and 35 cm (average, 31.5 cm) after surgery. Calf reduction was 3.5 to 6 cm (average, 4.5 cm) or 10.1 to 14.6 % (average, 12.5 %) (Fig. 1. and Fig. 2.).

Average follow-up in this series was 13 months. Seroma developed in one patient and resolved by repeated aspirations. Late hematoma developed in 2 to 3 months in three patients postoperatively. Only one of them needed surgical evacuation of blood clots (Fig. 3.). Incidental severance of the nerve to soleus muscle, a major complication, occurred in one leg. Immediate repair of the nerve was performed under operating microscope, and dragging of affected foot persisted for 6 months until complete recovery. No patient had numbness over lateral ankle and foot. Three patients had scar problems. Two complained of hyperpigmentation of the scar on the posterior midcalf and improved with intense pulse light treatment. The other patient had hypertrophic scar. All patients could walk and go upstairs or downstairs smoothly within 4 to 6 weeks, and could run and do exercise without difficulty within 3 to 6 months. All 10 patients in this series were satisfied with the surgical results without any impairment of leg function.
### Table 1. Resection of gastrocnemius muscles for muscular calves.

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age</th>
<th>Sex</th>
<th>Height</th>
<th>Previous Procedure</th>
<th>Preoperative Maximal Circumference cm</th>
<th>Postoperative Maximal Circumference cm</th>
<th>Calf Reduction cm (%)</th>
<th>Weight of Resected Muscle g</th>
<th>Complication</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>31</td>
<td>M</td>
<td>165</td>
<td>---</td>
<td>41</td>
<td>35</td>
<td>6 (14.6)</td>
<td>420</td>
<td>---</td>
</tr>
<tr>
<td>2</td>
<td>24</td>
<td>F</td>
<td>168</td>
<td>---</td>
<td>38</td>
<td>33</td>
<td>5 (13.1)</td>
<td>370</td>
<td>Seroma</td>
</tr>
<tr>
<td>3</td>
<td>33</td>
<td>F</td>
<td>157</td>
<td>Liposuction</td>
<td>36</td>
<td>31.5</td>
<td>4.5 (12.5)</td>
<td>330</td>
<td>Late hematoma</td>
</tr>
<tr>
<td>4</td>
<td>28</td>
<td>F</td>
<td>156</td>
<td>Liposuction</td>
<td>33.5</td>
<td>30</td>
<td>3.5 (10.4)</td>
<td>280</td>
<td>---</td>
</tr>
<tr>
<td>5</td>
<td>42</td>
<td>F</td>
<td>153</td>
<td>Liposuction</td>
<td>Right 34.5</td>
<td>Right 30</td>
<td>Right 4.5</td>
<td>Right 295</td>
<td>---</td>
</tr>
<tr>
<td>6</td>
<td>28</td>
<td>M</td>
<td>176</td>
<td>---</td>
<td>33.5</td>
<td>30</td>
<td>3.5 (10.4)</td>
<td>310</td>
<td>---</td>
</tr>
<tr>
<td>7</td>
<td>48</td>
<td>F</td>
<td>156</td>
<td>---</td>
<td>37</td>
<td>32</td>
<td>5 (13.5)</td>
<td>390</td>
<td>Late hematoma and injury of nerve to solet</td>
</tr>
<tr>
<td>8</td>
<td>27</td>
<td>F</td>
<td>156</td>
<td>Liposuction</td>
<td>35.5</td>
<td>31</td>
<td>4.5 (13.4)</td>
<td>310</td>
<td>---</td>
</tr>
<tr>
<td>9</td>
<td>28</td>
<td>F</td>
<td>162</td>
<td>Liposuction</td>
<td>35</td>
<td>30.5</td>
<td>4.5 (12.9)</td>
<td>430</td>
<td>Late hematoma</td>
</tr>
<tr>
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<td>F</td>
<td>157</td>
<td>---</td>
<td>34.5</td>
<td>31</td>
<td>3.5 (10.1)</td>
<td>250</td>
<td>---</td>
</tr>
</tbody>
</table>

*Resection of medial gastrocnemius muscle in patient 1
†Patient 5 had asymmetrical calf sizes.
Fig. 1. Patient 2
(A) A 24-year-old female with hypertrophic muscular calves, maximal circumference before surgery: 38 cm
(B) Both medial and lateral bellies of gastrocnemius muscle were pulled upward through popliteal incision
(C) Resected muscle weight: 370 g per calf (D) Twenty months after surgery, maximal circumference: 33 cm.
Fig. 2. Patient 10. (A) A 29-year-old female with maximal calf circumference measured 34.5 cm before surgery. 
(B) Five months after surgery, calf circumference measured 31 cm, hyperpigmentation of scar was noted.

Fig. 3. Patient 9. Sudden onset of progressive swelling over left calf due to hematoma occurring 2 months postoperatively. Surgical evacuation of hematoma was performed in this patient.
Discussion

There are few published documents, describing detailed definition of a beautiful leg. Popular belief on the street stalls is that “the maximal circumference of a beautiful leg in woman should be less than one fifth of her body height”. Tsai et al make an excellent scientific study describing criteria of the ideal female leg in Orientals. They reported the average length of the leg from popliteal crease to the heel was 26% of body height and average maximal circumference to be 32 cm (range 29 to 35 cm), about 75% of leg length. According to above criteria, all patients in our series were good candidates for treatment of their plump legs. Contrary to our general belief that man did not care the aesthetics of his legs, two of our patients were male, concerning their muscular calves.

Etiology of oversized calf can be classified into two major categories: pathologic and non-pathologic (Table 2). All patients seeking for treatment of the hypertrophic plump legs should be carefully evaluated to exclude any pathologic conditions such as edema from cardiac, hepatic or renal diseases, lymphedema, or deep vein thrombosis etc. Methods of aesthetic treatment for the non-pathologic hypertrophic calf include liposuction, neurectomy, partial or total resection of gastrocnemius muscle and intramuscular injection of Botulinum toxin A.

Liposuction is a popular technique used to treat fatty leg, but is indicated only for patients having thick subcutaneous fatty tissue greater than 1.5 cm in thickness. Advantages of liposuction include small incisional wound, small scar and minimal functional disturbance. However, many Oriental women do have hypertrophic muscular calves, liposuction doesn’t work. Four patients in our series had previous unsatisfactory liposuction of their legs.

Recently, neurectomy of the nerve to medial gastrocnemius muscle has been applied to paralyze the muscle with resultant loss of volume. This procedure can be done under local anesthesia in an outpatient manner. Other advantages of neurectomy are short operating and recovery time and less scar. Disadvantages include small reduction of the circumference of the calves, exaggerated bowing appearance of the lower extremities to the lateral side, unpredictable surgical results, recurrence of hypertrophic calves and possible injury of the nerve to soleus muscle. The best volumetric result of calf reduction achieved by this technique is no more than one half of the resection technique.

Table 2. Etiologies of oversized calf

   2. Lymphedema: congenital or acquired.
   3. Infection & inflammation: cellulitis, fasciitis or myositis.
   6. Trauma: contusion, hematoma.
   7. Others.

[B]. Non-pathologic: hypertrophy or hyperplasia of adipose tissue and/or muscle.
In 1998, Lemperle and Exner reported resection of gastrocnemius muscles in aesthetically disturbing calf hypertrophy for calf reduction in 15 patients. The resected muscles weighed between 410 and 810 g each (average, 560 g). Skin resection in 3 patients and circumferential liposuction of calves in one patient were also done. The original circumference of the calves, measuring between 36 and 48 cm (average, 43 cm), was decreased after surgery to 31 to 41 cm (average, 36 cm). Average of calf reduction was 16.3%. In our series, no patients had skin resection or simultaneous liposuction of the calf. Average of reduction in our series was 12.5%. The incision in the midcalf in our series shortened to 2 cm. The silicone drain was recommended to place for one week to prevent the seroma formation. Late hematomas occurred between 2 to 3 months postoperatively in 3 of our patients. The etiology was not known. Regarding the surgical scar, the horizontal scar over the popliteal fossa was well concealed in the skin fold and was insignificant. Three patients had problems of the vertical midcalf scar, which include two hyperpigmentation around the drain hole and one hypertrophic scar. The above problems was improved gradually with intense pulse light treatment and local steroid injection. Scar revision was not required in all patients. Informing the patient about the location, length and possible outcome of the scar preoperatively is of importance to patient's satisfaction after surgery.

Kim et al, in 2000, reported partial resection of gastrocnemius muscle with the aid of an endoscope. Their mean muscle resection was 132 g (range, 90 to 180 g) per calf. The mean value of the preoperative and postoperative maximal circumference of the midcalves was 36.4 cm and 32.4 cm. Calf reduction was 3.0 to 7.0 cm. The results are different as compare the total resection in our series.

Both the surgeons and patients concern postoperative leg function. Gastrocnemius and soleus muscles play different roles in maintaining an erect posture and in locomotio. Gastrocnemius muscle is a flexor of both knee and ankle joints. The function of gastrocnemius muscle on ankle joint can be taken over by soleus and on knee joint be taken over by flexor muscles of the thigh. Some experiences of to gastrocnemius muscle transfer for reconstructive purpose in the past showed no influence leg function. In contrast, resection of the soleus was followed by a significant 50% reduction of the earlier strength. Our series results are similar to previous reports indicating that resection of partial or total gastrocnemius muscle has no severe impairment of leg function. Kim et al used Cybex test to measure the muscle tone and power objectively. They showed normal muscle power of the calf was regained between 6 months and 12 months postoperatively.

Incidental transection of the nerve to soleus muscle occurred in one leg in this series. The nerve was repaired immediately under operating microscope. This patient suffered from prolonged dragging of one foot for 6 month until full recovery occurred. According to Hwang et al study, the nerve to soleus muscle originates from the nerve to lateral gastrocnemius muscle in 30%. Meticulous dissection should be taken to identify the nerve to soleus muscle between ligation and division of the neurovascular bundle to both head of gastrocnemius muscle. Also, careful protection of the medial sural cutaneous nerve is mandatory to prevent sensory disturbance of the lateral foot.

More recently, intramuscular injection Botulinum toxin A was used for contouring oversized calves or sculpturing the shape of muscular leg. This method has the advanage of no-surgery and no-scar. Disadva...
include insignificant calf reduction, short-term effect and necessity of repeated injections.

Conclusion

Total resection of gastrocnemius muscle is able to result in adequate calf reduction without severe impairment of the leg function. Although all the patients in this series were gratified with the final results of calf reduction except the resulting scar, the time needed for recovery of muscle power in leg could be as long as 6 months in some patients. There is one major complication of injury to soleus muscle in this series with resulted prolonged dragging foot for 6 months until full recovery occurred. Understandingly, this surgery is indicated only for well-informed and psychologically disturbed patients. Also, surgeon performing this operation should be familiar with the regional anatomy in order to prevent neurovascular injury. Simultaneous liposuction is suggested in selected patient with thick adipose tissue to achieve more significant reduction.

Reference