The Ertl Osteomyoplastic Transfemoral Amputation Reconstruction: Description of Technique and Long Term Results.

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Abstract

Seventy two patients with seventy four symptomatic transfemoral amputated residual extremities were operatively treated by two surgeons experienced in the osteomyoplastic reconstruction technique. Patients were reviewed an average of 9.8 years postoperatively, with a range of 2 to 15 years. The average age at reconstruction was 57.4 years. The primary amputations were performed as a result of trauma in 60%, peripheral vascular disease in 20%, infection in 6% and tumor in 4%. Symptomatic patients were referred for a combination of residual extremity pain, muscle atrophy, redundant soft tissue, bony exostosis, poor prosthetic fit and cutaneous prosthetic interface difficulties, resulting in the inactive residual extremity syndrome. Surgical reconstruction was performed only after non-operative attempts had failed to improve upon their symptoms.

The long term results were determined by a 30 point clinical assessment score, integrating subjective and objective evaluation parameters, comparing pre and post-operative symptoms. of the 72 patients 67 patients were rated as good or excellent, 2 as fair and 3 as poor. The poor results occurred in patients with peripheral vascular disease, one patient being a bilateral amputee. The osteomyoplastic reconstruction technique provides a stable durable and active residual extremity with lasting improvement and high patient satisfaction and not limited to transtibial amputations.

Description of procedure: Transfemoral

The patient is informed of the surgical risks and complications. All attempts are made to maintain residual extremity length to spare the cost of increased energy expenditure. A diagrammatic transverse section at the appropriate transfemoral level and side is helpful during surgery. If available, the previous operative report should be reviewed . The treatment and description of the muscles and nerve should be noted to assist in the dissection.

The extremity is prepared in standard fashion. A tourniquet is placed, however may not always be feasible and a sterile tourniquet may be used. A bump is placed under the hip of the involved extremity to assist with rotational control. The previous incisions are identified and utilized.

Dissection is carried to the muscular layer. The muscles are often retracted and atrophic necessitating proximal dissection and muscle identification. The adductors,

abductors, quadriceps, and hamstrings are isolated in their respective groups. The fascial or more often scar tissue attachments are maintained for subsequent myoplasty.
The neurovascular structures are identified, released from scar and separately isolated. It is important to separate the nerve from the artery if the neurovascular structures have been ligated together, to avoid the pulsatile irritation of the nerve. The sciatic nerve may be identified by palpation of its neuroma, which may reach sizes up to 4 cm. The nerve trunk is mobilized by blunt dissection, distracted and transected at a proximal level allowing retraction into soft tissue surroundings. If a tourniquet has been used, it may be released to evaluate bleeding. The vascular structures are often friable and need to be handled carefully to avoid possible proximal retraction. The artery and associated veins are separately ligated to avoid arterio-venous connections.

Attention is directed towards the distal residual femur. All exostosis are removed and the periosteum incisized anterior to posterior. Utilizing a 45 degree angled chisel, medial and lateral osteoperiosteal flaps are elevated maintaining their proximal attachments. Elevation of the flaps is aided by rotating the chisel 180 degrees lifting and maintaining the osteoperiosteal attachments. The femur is transected at the level of the osteoperiosteal flaps with minimal femur being removed. The medial and lateral flaps are sutured over the end of the open medullary canal.

The myoplasty is performed by suturing the antagonistic muscle groups to each other or anchoring them into the periosteum, covering the osteoplasty. The adductors are sutured to the abductor group or the adductor group is anchored to the lateral femoral periosteum and the abductors imbricated over the abductor attachment. This order assists in centralizing the femur and avoiding lateral deviation. The flexors are sutured to the extensor group and to the underlying adductor/abductor groups, to maintain centralization of the distal femur.

The skin is fashioned to the underlying myoplasty in a symmetric fashion avoiding dogears and invaginations of the incision. A smooth contour is the goal to allow a better limb prosthetic interface. Penrose drains are placed prior to completion of the closure.

Postoperatively the residual extremity is placed in an ace wrap hip spica or a bulky plaster splint. Sutures are removed at 2 to 3 weeks depending on wound healing. Temporary total contact end bearing prosthetic fitting is coordinated with the patients prosthetist between 6 and 8 weeks postoperative. Physical therapy is initiated for transfers, range of motion, aerobic conditioning and upper body strengthening.

Materials And Methods - Transfemoral

Between January 1980 and January 1995, 93 transfemoral osteomyoplastic amputation reconstructions were identified in ninety one patients. There were two bilateral amputees, 13 patients were deceased and 6 were lost to follow-up. Seventy two patients with seventy four transfemoral reconstructions with a minimum 2 year follow-up were available for review. The average post operative follow-up was 9.8 years with a range from 2 to 15 years. There were 40 males and 32 females with an average age at

operation of 57.4 years, with a range of 29 to 79 years. There were 37 right and 37 left lower extremities involved. The initial cause of amputation were traumatic in 60% (43), peripheral vascular disease in 30% (22), infection 4% (3) and tumor 6% (4). The average time to surgical reconstruction after primary amputation was 13.3 years, with a range of 10 months to 40 years. Surgical indications included a combination of residual extremity pain, bone and muscle atrophy, swelling, weakness, poor prosthetic fit and cutaneous breakdown, resulting in decreased activity. The combination of symptoms resulting in the "inactive residual extremity syndrome", as the residual extremity tissues are essentially inactive in ambulation.

The residual extremity was examined for hip flexion contracture, localization of pain, presence of exostosis and general extremity condition. Hip flexion contractures were treated with physical therapy and cutaneous lesions and breakdown were treated with local wound care and activity modification prior to surgical intervention. Palpation of the residual extremity was performed for bony tenderness and that of neuromatous origin. Palpation of bony exostosis may demonstrate pain and crepitation from bursa formation and soft tissue irritation. The soft tissues are evaluated for bulk, muscle control and centralization of the residual femur.

Preoperative roentgenographic evaluation of the residual femur consisted of AP, lateral, internal and external obliques. These were evaluated for residual bone length, osteopenia and exostosis.

In attempts to quantify our results a rating system was developed incorporating the patients most frequent complaints and symptoms. The scoring system was modeled after other point systems (Weber/Hughes,Goldberg, Ertl). The resultant clinical score provided us with an objective means of assessing our results and patient improvements.

Pre and post-operative residual extremity symptoms of pain, function, stability, swelling and length of prosthetic wear were obtained. Post-operatively all patients were evaluated by one of the authors. The final evaluation consisted of a questionnaire regarding residual extremity pain, function, swelling with use, hours of prosthetic wear and subjective stability. The overall patient satisfaction was also requested. Roentgenographic review of residual or recurrent exostosis were evaluated on four views.

The femur was divided onto four planes, medial, lateral, anterior and posterior. In this category 5 points were awarded for no exostosis and one point was subtracted for exostosis in any plane.

The evaluation criteria were integrated into a six category, 30 point clinical assessment score with each category worth 1 to 5 points (see chart). In this 30 point scoring system a point total of 25-30 was considered excellent, 20-24 good, 15-19 fair and <15 as poor.

Results - Transfemoral

Overall: 72 patients with 74 transfemoral osteomyoplastic residual extremity reconstruction with greater than 2 year and average 9.8 years follow-up were available for review.

The final overall results using the 30 point rating system demonstrated 70%(52) excellent, 20%(15) good, 4%(3) fair and 6%(4) poor. The overall patient satisfaction was 95.8 %. These patients felt their final result improved the residual extremity function and quality of life and would repeat the surgery again. The 4 poor results occurred in 3 patients, one bilateral amputee, with peripheral vascular disease. These patients were placed in this category as they continued to experience extremity pain inspite of improving in other parameters. In these 3 patients pain was the limiting factor in ambulatory ability and length of prosthetic wear resulting in a limited functional result and an overall poor rating.

The overall results using the 30 point clinical assessment score for all patients was 25.01. Post traumatic amputees demonstrated a mean score of 26.2 points and vascular amputees demonstrated a mean of 21.6 points.

Clinical Assessment Score - Transfemoral

1. Pain
    a. no pain/ignores 5
    b. slight pain/no compromise in acivities 4
    c. mild pain with normal activity 3
    d. pain with standing in prosthesis 2
    e. pain w/o prosthesis 1

2. Function
    a. unlimited walking ability 5
    b. 6-12 blocks 4
    c. 2-5 blocks 3
    d. 1-2 blocks 2
    e. indoors only/wheelchair assistance 1

3. Stability
    a. no weakness/no limitations 5
    b. difficulty with uneven terrain 4
    c. difficulty with stairs/inclines 3
    d. extremity weakness 2
    e. walking aids (cane/crutches) 1

4. Swelling of residual limb
    a. none/minimal/no socket compromise 5
    b. with walking 6-12 blocks 4
    c. with walking 2-5 blocks 3
    d. with walking 1-2 blocks 2
    e. with indoor walking 1

5. Hours of prosthetic wear

a. 14-18 hours 5
b. 10-13+ hours 4
c. 6-9+ hours 3
d. 3-5+ hours 2
e. 1-2+ hours 1

6. Radiographs
a. no exostosis 5
b. one plane exostosis 4
c. two plane exostosis 3
d. three exostosis 2
e. four plane exostosis 1

Grading

excellent	25-30 points
good	20-24 points
fair	15-19 points
poor	< 15 points

Pain: All patients complained of preoperative residual extremity pain of varying degrees. The average pre and postoperative score for pain were 2.3 and 4.6 respectively. The average decrease in pain was 2.4 points. A total of 69 patients obtained pain relief while 3 vascular patients showed no improvements.

Function: The average pre and post-operative scores were 2.4 points and 4.2 points respectively, with an average overall improvement of 1.8 points. The patients commented to have made great gains in function as they felt their residual extremities were stronger with greater control. Although modest, two patients in the poor group improved one level in function. The remaining patient in the poor category was a bilateral vascular amputee, whose conditioning made it impractical to pursue ambulation.

Subjective stability: Stability was expressed as residual extremity control, subjective strength and precieved proprioception. The average pre and post-operative scores were 2.0 points and 4.45 points respectively. An average increase of 2.45 points. With the increased sense of stability patients felt their confidence and function improved. All but the bilateral vascular amputee felt they achieved improvements in this category.

Swelling: Patients had lesser complaints of swelling preoperatively than was noted in the transtibial population. The average pre and postoperative score for swelling was 3.1 points and 4.45 points respectively. The average decrease in swelling of the reconstructed residual extremity improved 1.2 points.

Length of prosthetic wear: The average pre and post-operative average time of prosthetic wear was 8.2 hours/day and 13.7 hours/day respectively. The average increase in prosthetic wear was 5.5 hours/day. This correlated to an average pre and post-operative score of 2.4 points and 4.3 points respectively.

Radiographs: Medullary canal closure was evaluated radiographically by the presence of residual exostosis or recurrent exostosis formation. Attempts were made to remove all preoperative exostosis which in 2 patients was extensive it became unfeasible and destructive. No recurrent exostosis occurred. The two patients with residual preoperative exostosis required later resection secondary to soft tissue irritation and pain about this prominence.

Conclusion - Transfemoral

The efforts of the osteomyoplastic procedure are directed at creating a functional and active residual extremity based on reestablishing a physiologic environment. The resultant residual extremity will afford the amputee with a stronger, more durable extremity with improved stability and proprioception. This reconstruction will ultimately provide an improved dynamic limb-prosthetic interface. We have applied this technique to both initial and secondary amputation.

Minimal bone is removed on creating the osteoperiosteal flaps and performing the osteoplasty. In addition to centralizing the femur and improving vascularity, the overlying myoplasty will contribute to overall residual extremity length.

The osteomyoplastic lower extremity amputation reconstruction is technically challenging than conventional amputation techniques and is not limited to the transtibial level. This procedure offers the surgical community a dynamic procedure for both primary and secondary reconstruction in lower limb amputation surgery, with high patient satisfaction.

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