

SDC 1: Appendix of terms, principles and tissue specific procedures performed at stumpoplasty

Physical issues specific to the post ballistic stumps influence management decisions. This appendix is to clarify the reasoning behind the options and procedures selected at stumpoplasty.

This table lists the three tissue components that can be revised at stumpoplasty and the potential surgical options.

Tissue to be revised Surgical team applied	Options of procedure
Bone Elements: Orthopaedic care	Minor shortening for tip issues <ul style="list-style-type: none"> • <i>Bevel and shorten</i> • Minor trimming of bone prominence True shortening <ul style="list-style-type: none"> • Excision for infection/OM • <i>Shorten bone left too long at amputation (technical error)*</i> • Shortening to allow movement local soft tissue to enhance tip padding Change level of amputation <ul style="list-style-type: none"> • Move amputation proximally by one joint Remove fibular remnant <ul style="list-style-type: none"> • <i>For prominence *</i> • For CPN hypersensitivity Address joint contracture <ul style="list-style-type: none"> • Ligaments/ joint releases/ muscle release or lengthening
Soft tissues revision: Plastic Surgical care	Change stump contour <ul style="list-style-type: none"> • <i>Whole profile revision *</i> • <i>Debulk *</i> • Move local tissue to Enhance tip padding Excise or revise unwanted elements <ul style="list-style-type: none"> • Primary amputation scar • Graft and scar tissue • <i>Crypts *</i> • <i>Foreign bodies *</i>
Neural element revisions: Orthoplastic care.	Address neural problems <ul style="list-style-type: none"> • Neuromas • CPN hypersensitivity
Infective process/OM: Orthoplastic care	Debridement <ul style="list-style-type: none"> • Debride and excise bone • Debride and excise sinuses and soft tissues

Italics *: Issues that could be mitigated at primary amputation to avoid the need for stumpoplasty

Principles of Bone Management explained

1) Bone length measurement and short-stumps.

Bone length of the stump was measured and classified as follows.

- A short BKA stump was defined as a tibial length of less than 12cms measured from joint line to distal tibial bone tip.
- A short AKA stump was defined as a femoral length of less than 20cm measured from the anterior superior iliac spine (ASIS) to the distal femoral bone tip.

Considerations: These are arbitrary, standard measurements. Problems arising from applying a fixed bone length to define short or long stumps include:

- 1) These values are arbitrary. There is no standardised, ideal bone length for a residual femoral or tibial segment.
- 2) Arbitrary values do not take into account the amputees overall stature and height.
- 3) Points from which the measurements are taken can vary in the literature e.g. for the femur, measurements can be from ASIS or the greater trochanter.
- 4) Whether a short stump can be fitted or not is dependent on the prosthetist's skill as well as the residual bone length.

2) Definition of true bone shortening versus minimal bone shortening.

- Minor bone shortening and bevelling reshapes the bone tip for bone prominence. Bone shortening is not the goal, but a consequence, of this tip revision.
- True bone shortening involves excision of a bone segment. This was applied for excision of infected bone (debridement) or excision of excessive bone length either left at primary amputation or acquired by growth. The goal is not to reshape the bone tip but to remove unwanted bone. The result is a shortened bone segment.

3) Bone infection: Osteomyelitis

The clinical diagnosis of possible chronic osteomyelitis (OM) was based on

- history, symptoms, and signs,
- serology
- radiological evidence

Considerations: Confirmation of OM was based on culture positive, intra-operative bone samples: Five separate biopsies were taken per case for diagnosis at stumpoplasty.

4) Management of the fibular remnant

The diagnostic criteria for prescribing removal or trimming of the fibular remnant by MDT was either

- a) Common peroneal nerve (CPN) hypersensitivity.
- b) Prominence of fibular bone impacting on socket fit

Considerations: CPN hypersensitivity definition

CPN nerve hypersensitivity and fibular remnant issues can only be present in BKAs.

It was defined as pain perceived in the stump on pressure, or percussion, of the CPN at the neck of the fibula. Clinically, no neuroma trigger points were found distal to the percussion point that could relate to the CPN end or its terminal branches.

Principles of Soft tissue Management explained

1) Scar revision

There are two constant facts relating to amputee stumps that require stumpoplasty:

- 1) All will need an incision for surgical access.
- 2) The post-traumatic stump will not be left with tidy wounds at primary amputation.

Considerations: At stumpoplasty, the need for re-incision presents an opportunity to improve post-traumatic and post-operative scars. This gesture may be as much for cosmetic reasons than for functional reasons. Scar revision as part of stumpoplasty was proportionate to the access required for surgery aimed at addressing functional issues only. No scar was revised just for cosmetic improvement alone. The minor gesture of improving the scar cosmesis was well received by patients.

2) Change of stump contour

Total revision of soft tissue contour was a global term. It is used to indicate any combination of soft tissue revisions that result in an overall improved stump shape. The goal of the improved overall shape was to allow better socket fit, prosthetic retention and stump stability within the socket.

Considerations:

Change stump contour can involve

- **Debulking of soft tissue:** Enhance the stream line form of the stump to allow better socket fit hence prosthetic retention
- Move local tissue to **Enhance tip padding:** Enhance stump comfort in the socket and prevent ST breakdown over bony prominences.

Floppy stumps fit poorly in prosthetic sockets. The shear between soft tissue and bone causes balance issues. Soft tissue and adiposity were found to abound in the AKA amputation stumps. The tight and tethered soft tissues in short-stumped BKAs made tissue excess rare.

3) Adequate stump tip padding.

To fashion a good stump the surgeon must judge the difference between too much padding and not enough. Deficient stump tip padding can lead to breakdown of the stump over bony prominences. Too much soft tissue padding will cause socket fitting and balance issues.

Considerations:

The challenge in this cohort is short stumped BKAs with tense tethered tissues, scar tissue and minimal laxity. Mobilisation and advancement of this ST risks tissue necrosis.

The options at stumpoplasty to increase tip padding depend on the quality of local ST and the length of bone remaining in the stump.

- For well vascularised, supple tissues: Tissues can be mobilised, advanced and re-drape without tension.
- For tight, short stumps: Minimal judicious bone shortening may be necessary to achieve adequate soft tissue cover. Minimal ST undermining and mobilisation is possible. Tension must be avoided at ST closure.

4) Soft tissue Excisions

This encompasses scar revisions and excision of unwanted soft tissue elements

Considerations:

Below are the indications for soft tissue excisions

- **Skin Graft excision:** Considered only where graft on the stump could interfere with prosthetic use (break down and maceration).
- **Crypts:** Excised on areas contained within the silicone liner to prevent maceration, infection, and hair ingrowth.
- **Foreign bodies:** Symptomatic shrapnel (pressure pain) or shrapnel prone to episodes of infection (history).

5) Myodesis and Myoplasty: creation of a dynamic muscle sling for the AKA stump.

Burgess 1969⁽³⁾ emphasised the “prime requisite” both in AKA and BKA stumps is for “stump muscle stabilisation” i.e. attachment of the sectioned muscle to bone (myodesis) or attachment of the sectioned muscle to opposing muscle (myoplasty)

In the BKA the long posterior composite flap of gastrocnemius and soleus is attached to anterior fascia of or anterior periosteum so is neither myoplasty nor myodesis. Dynamic flexion and extension of the knee joint are not motored by muscle components of the stump flap but by the quadriceps and hamstrings.

In the AKA both myodesis and myoplasty are combined so that opposing adductors and abductors, as well as flexors and extensors, work as a dynamic sling. The muscle balance avoids abduction and flexion contracture as well as providing the motors for stump movement.

Considerations:

In this study, term revisions of Myodesis/myoplasty were applied to the AKAs since a dynamic, functional muscle sling had been created at primary AKA amputation for motor function. In the BKA of the cohort, tip muscle is there as part of a composite flap and for padding only.

Principles of Neural tissue Management explained

1) Neuromas

Peripheral nerve neuroma formation was recorded as clinically present if, on examination, a clear trigger point could be demonstrated in the anatomic location corresponding to the severed nerve or its branches.

Considerations:

Consideration of the correct management of asymptomatic, structural neuromas localised incidentally at surgery needs to be clarified. At the time of this study, there is still no gold standard for neuroma treatment but several techniques are generating promising results. Regenerative peripheral nerve interfaces and targeted muscle re-innervation need to be considered both at primary amputation and stumpoplasty.

2) CPN hypersensitivity

CPN nerve hypersensitivity has already been defined above under the section on considerations for the treatment of the fibular remnant.

Considerations:

This was common in BKA cases in this study with short stumps and small fibular remnants. This problem could be possibly be mitigated by action at primary amputation. If the patient is destined to have a short stumped BKA, the fibular remnant could be removed primarily to avoid this symptom later.