Secondary Reconstruction after BPI

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GOALS

- Informed, realistic patient
- Holistic welfare addressed through MD care team
- Pain control optimised
- Lifeboats not burned
- Shoulder stable
- Elbow range 0->90^{o}
- Grasp restored
- Protective / coarse sensation
- The limb feels part of me
- Hand reanimation unrealistic unless some elements present

Common secondary issues

Pain

Motor control

Sensory symptoms

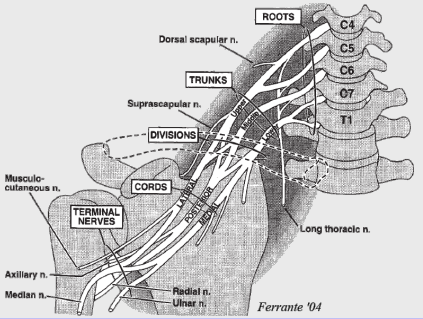
Scarring

Vasomotor change

Function

- Loss of employment & psychological impact
- Loss of hobbies & psychosocial morbidity
- Psychosexual impact

OBPI Shoulder



Spinati palsy + subscapularis contracture

70% develop glenohumeral deformity

Conservative management

- Physiotherapy

Surgery in ~20%

- subscapularis release
- rotator transfers
- shoulder relocation / humeral osteotomy

Common secondary issues

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Scar management

Conservative techniques

- time + massage + moisturise
- silicone
- pressure

Secondary interventions

- intralesional steroid
- tattoo
- surgical resurfacing – broad areas of scar, or to prepare for further secondary surgery
- surgical revision +/- plasties

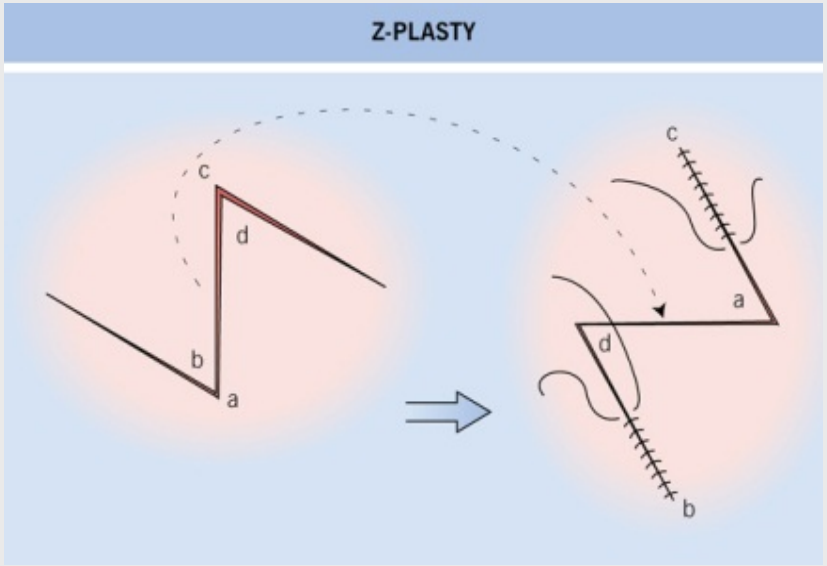
Contracture release

Joint or scar contracture may arise secondary to ischaemic fibrosis of muscle, to suboptimally aligned cutaneous scars, or secondary to inadequate maintenance of passive range

Plasties

Flaps

- Skin flaps most suitable
- Thin perforator flaps ideal
- Local / pedicled / free



Vasomotor change & Cold intolerance

Vasomotor reactivity

- “inappropriate” change in small vessel tone resulting in purple / red / white colour change, often with associated perception of swelling
- can cause psychosocially crippling negative body-image issues

Cold intolerance

- temperature related pain / reduced sensation / vasomotor reactivity / stiffness

Interventions

- sensory nerve reconstruction
- cosmetics advice
- botox
- warming measures

Secondary pain surgery

Neurolysis

- release of nerves from scar entrapment +/- flap cover
- traction vs compression
- mixed results, more appropriate for infraclavicular injury

Motorisation

- increased functionality often associates with reduced pain

Amputation

- most appropriate for chronic infection / tissue viability indications

Botox? Steroid? Guanethidine?

Neurosurgical (spinal) procedures

Sensory procedures

Sensation

- non-visual control
- feeling limb is part of you
- reducing phantom sensation

Secondary nerve transfers

- cervical plexus to median nerve
- cross-neck C7 to lower trunk
- intercostal nerve sensory branches

Function

Realistic assessment of what can / can't be achieved

- time after injury
- co-morbidity
- age
- compliance with rehabilitation
- balancing surgical vs non-surgical options – role of OT, prostheses, counselling

Consider

- stabilisation
- motorisation
- patient driven prioritisation & staging of procedures

Nerve transfers

Sensory:

- ICN / cervical plexus to brachial plexus (typically routing towards median nerve)
- Distal fascicle transfer

Motor

- intra-plexal vs extra-plexal
- Shoulder: XI→SSN, Triceps branches to axillary
- Elbow: Ulnar / median nerve fascicles to MCN
- Forearm: median PT / FDS fascicles to radial / PIN
- Hand: AIN to motor branch of ulnar

Cross-neck

- “academic success”

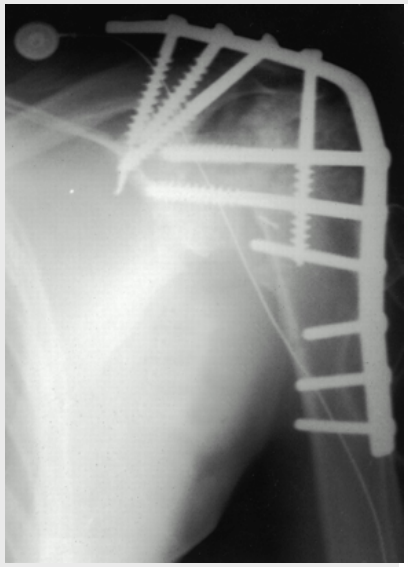
Joint fusions

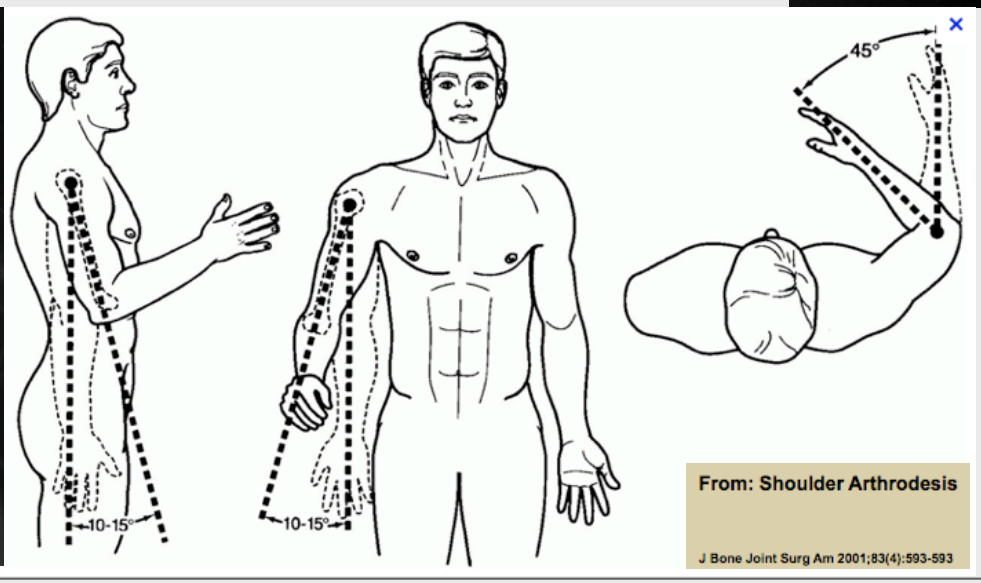
Wrist

Useful adjunct to stabilise hand for function

Preliminary trial of static splint

May free tendons for transfer to motorise digits





Glenohumeral

Require good scapular control

Range of movement

Makes limb “part of you”

Tenodeses

Fixation of a paralysed muscle-tendon unit to limit joint range of movement

Role in growing bone to mimic fusion without affecting growth

e.g. fixation of wrist extensors to radius

Role in allowing a different intact movement to create additional beneficial control of a joint

e.g. FPL tenodesis in the extensile wrist

Indications & techniques evolving

Secondary reanimation

After ~9 months of denervation there is little point trying to reinnervate muscle

Early secondary nerve transfers

- triceps branch to axillary nerve
- median nerve to radial nerve fascicle transfer

Tendon transfers

- shoulder & elbow options limited
- hand & wrist – multiple potential options

Functional muscle transfer

Tendon transfers

Transfer of a functional muscle-tendon unit to power a more useful function

Requirements:

- Synergistic & MRC grade 4/5 power
- Dispensible function
- Vectoring
- Healthy soft tissue routing & passively mobile joint

Hand & wrist: EI opponensplasty, FCR to EDC, EE4T…

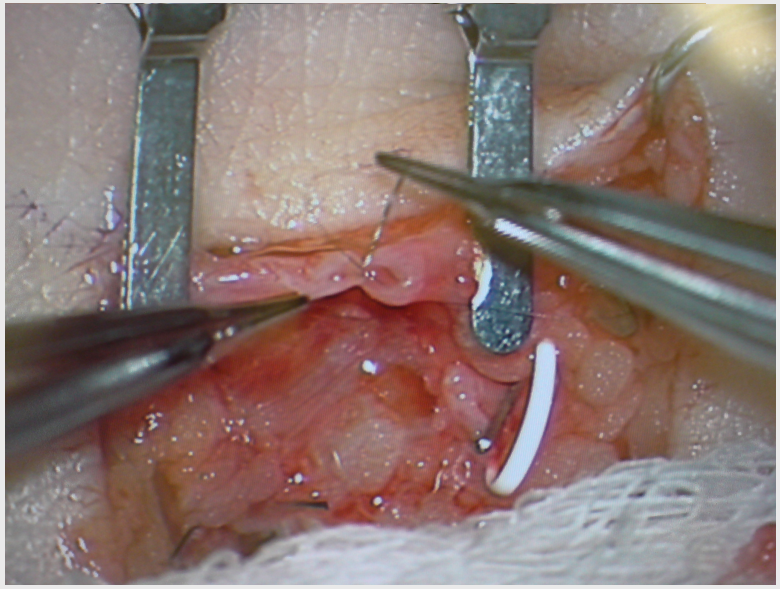
Shoulder: LD external rotation transfer

Flap transfers

Soft tissue optimisation

Bone reconstruction

Functional muscle transfers



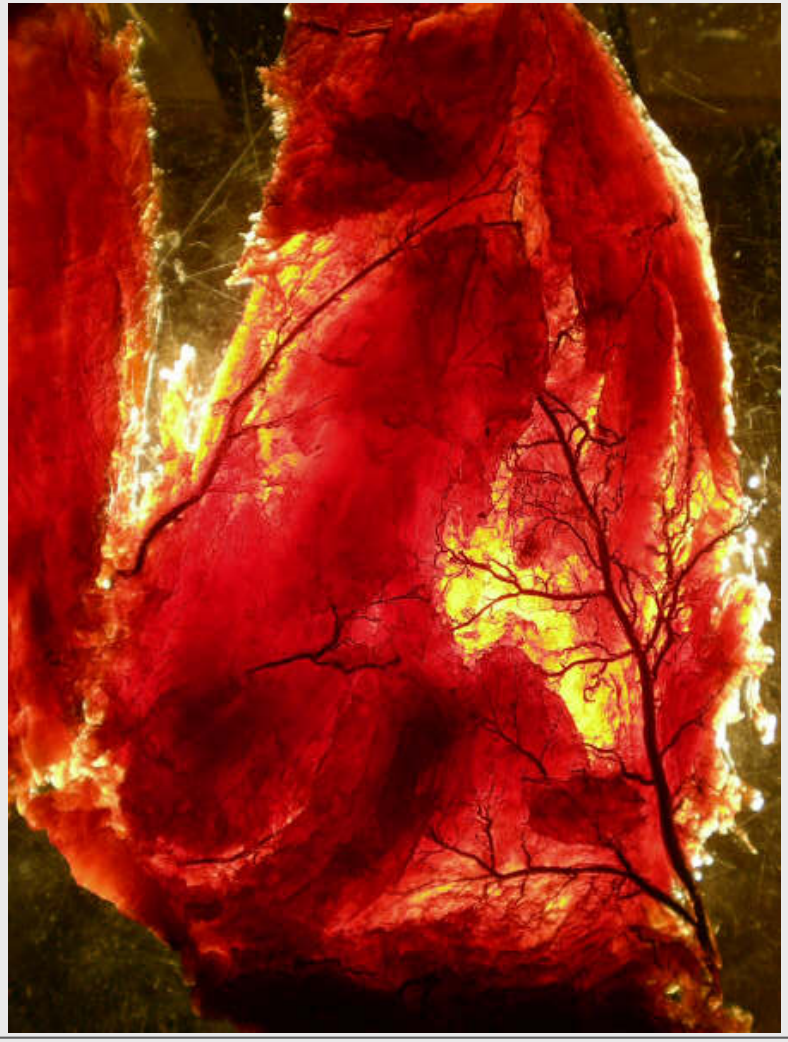
Tailor donor to recipient defect requirements, patient factors & operative logistics

Longer procedure, specialist units, high dependency post-operative care

Safe in children & fit elderly

Cost-effective

Functional Muscle Flap Transfer



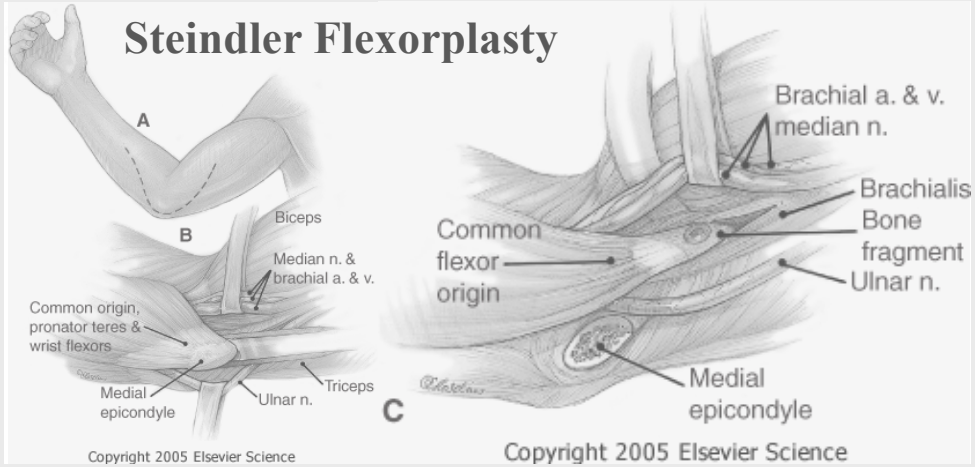
Transplantation of a viable muscle-tendon unit with the primary aim of restoring motor function

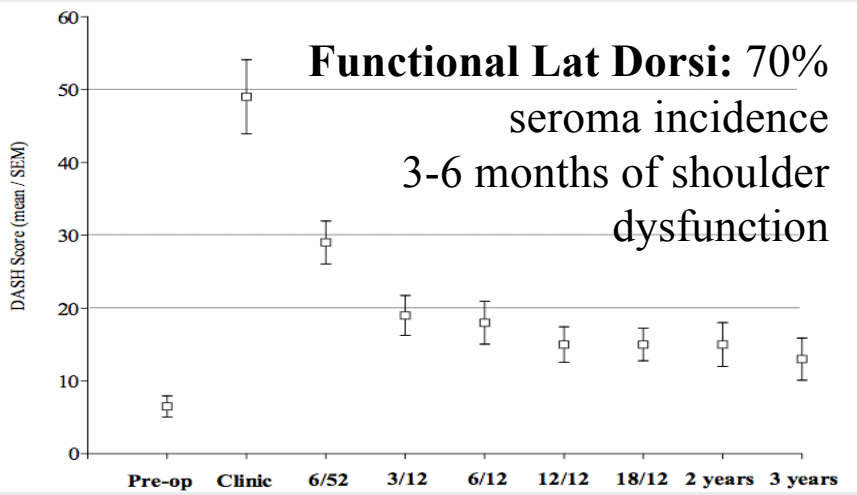
Extension of the tendon transfer principle

Muscle / myocutaneous flap

Pedicled / free tissue transfer

Reanimating Elbow Flexion





Pec Major transfer:

- Weakened shoulder
- Poor, stigmatic cosmesis

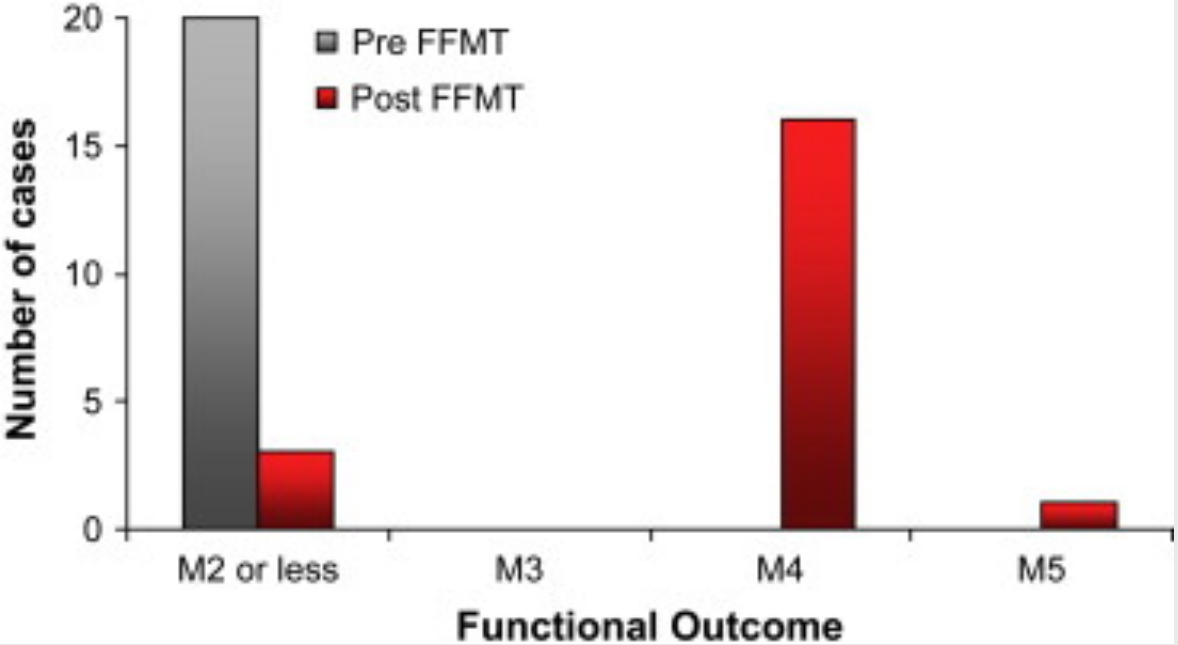
Free Functional Gracilis Flap:

- No motor impairment
- Hidden scar

Salvage Options:

Muscle transfers; tendon transfers; joint fusion

Kay, Pinder, Wiper, Hart Jones & Yates JPRAS 2009



37 flaps in 33 patients, predominantly BPI / biceps reconstruction

13 adults (median 34 years) 20 children (median 5 years)

Free functional gracilis transfer

Kay, Pinder, Wiper, Hart Jones & Yates JPRAS 2009

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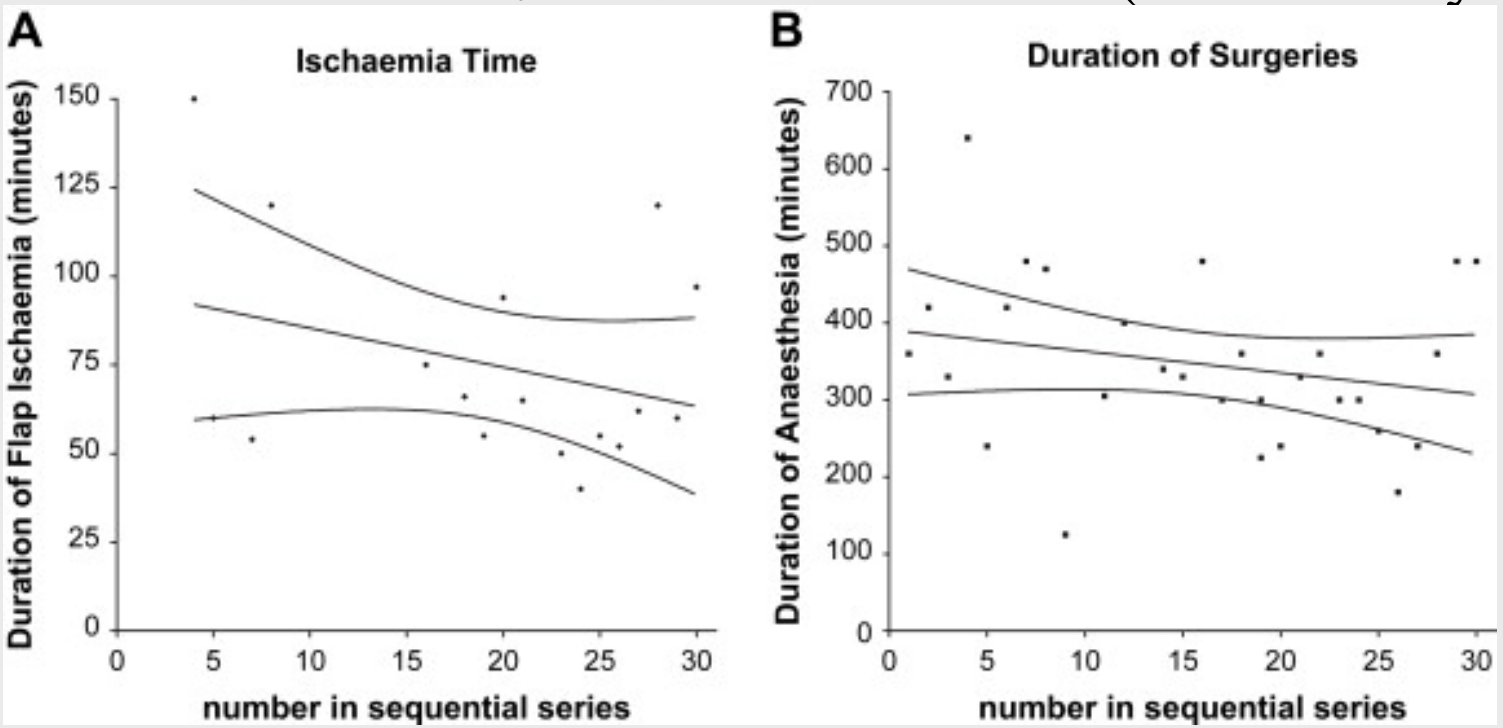


Free functional gracilis transfer for multiple functions

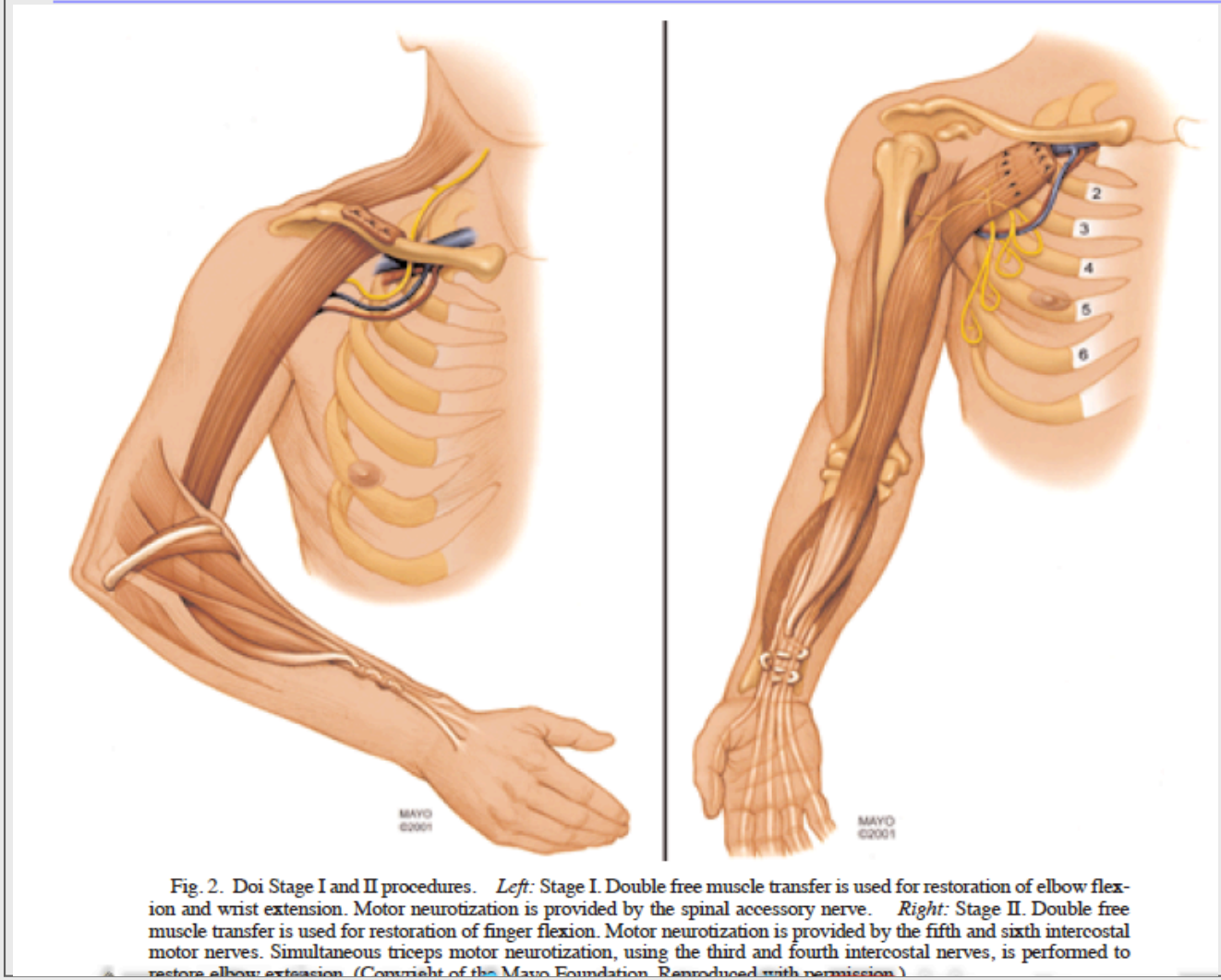


Fig. 2. Doi Stage I and II procedures. *Left:* Stage I. Double free muscle transfer is used for restoration of elbow flexion and wrist extension. Motor neurotization is provided by the spinal accessory nerve. *Right:* Stage II. Double free muscle transfer is used for restoration of finger flexion. Motor neurotization is provided by the fifth and sixth intercostal motor nerves. Simultaneous triceps motor neurotization, using the third and fourth intercostal nerves, is performed to restore elbow extension. (Copyright of the Mayo Foundation. Reproduced with permission.)

Barrie et al, Neurosurg Focus 2004;16(5):Article 8

Doi double FFMT for elbow flexion & prehension

Motor outcomes worse than for single function transfers (cf tendon transfer) *63% vs 79% achieving MRC≥4*

Mayo Clinic results, 2004

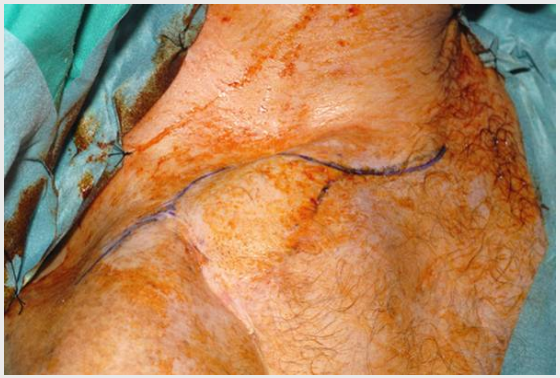
Free functional gracilis transfer:
poorer results in forearm

Pan plexus injury
FFGTx clavicle to EDC

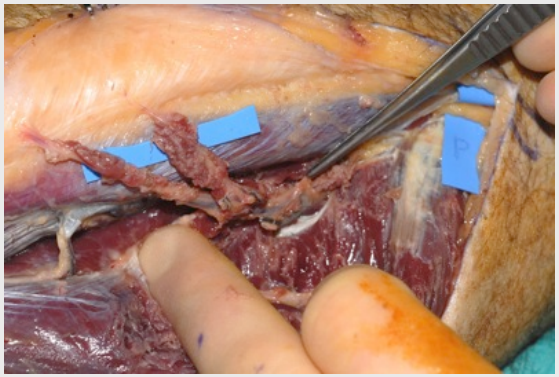
Malabsorption syndrome,
profound weight loss

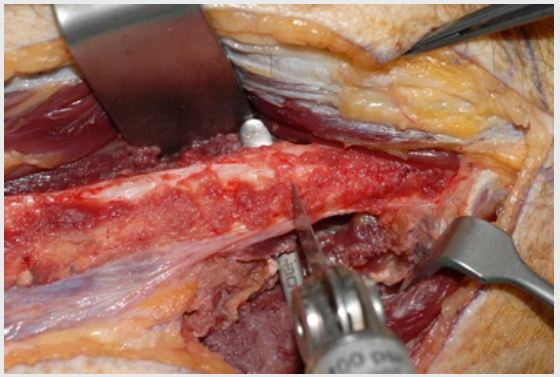
Bone stabilisation precedes soft tissue work

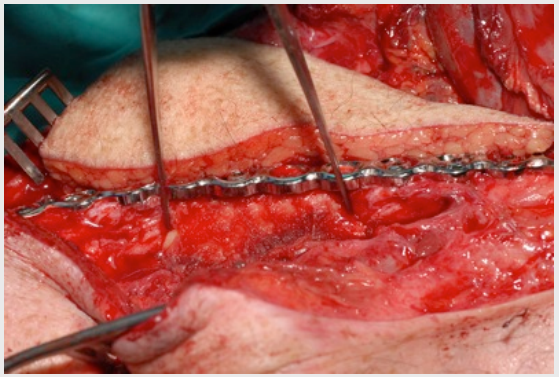
Clavicle non-union after multiple brachial plexus explorations



Commence dissection posteriorly, release soleus,FHL & TP



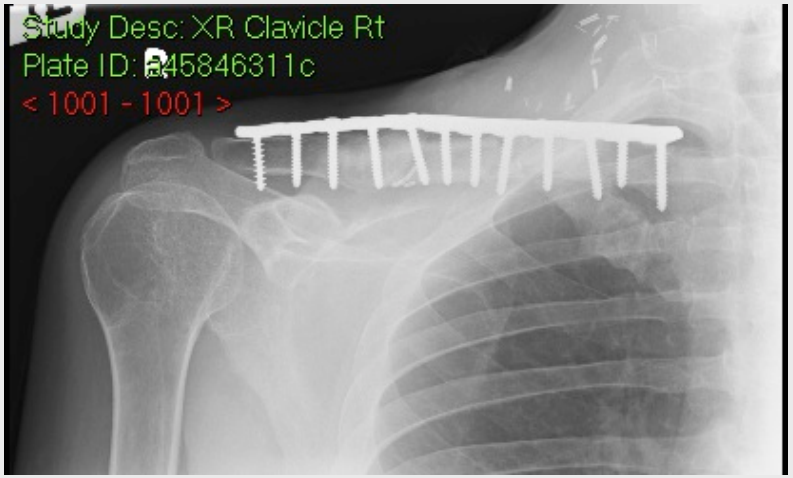




Skin paddle supplied by popliteal perforator in this case, bone by peroneal vessels

Bone stabilisation precedes soft tissue work

Clavicle non-union after multiple brachial plexus explorations



Neurolysis & Stable clavicle – less pain

No chronic wound – psychology & life benefit

Prepared way for elbow reanimation

Hand became a functional body part again

Independent function & “hug again”; Discharged after ~20years of medicalisation

Amputation

Seemingly logical solution to the “failed” nerve reconstruction, particularly flail limb

However

- a one-way street
- evidence of benefit vs. neurogenic pain unsupportive
- balance against potential outcome from secondary procedures

Levels

- Forearm / Upper arm / Forequarter

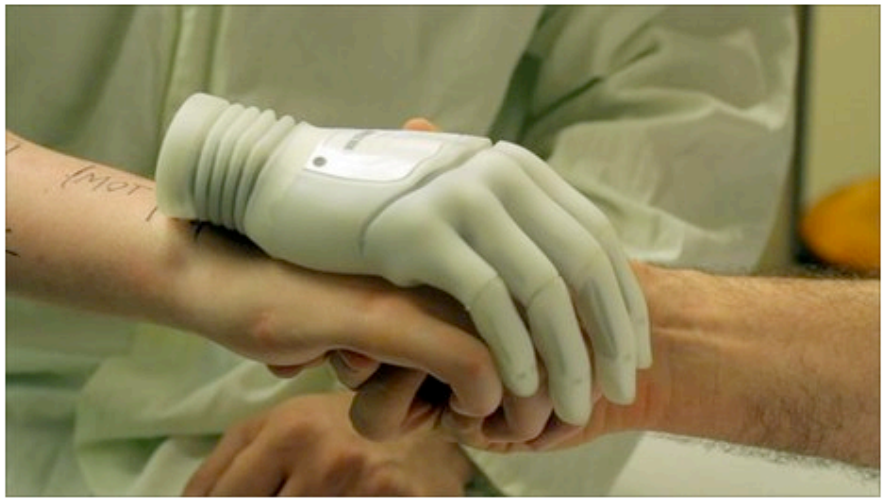
Requirements

- Clear appreciation of likely outcome of current injury
- Clear appreciation of likely outcome of amputation
- Counselling & Psychology assessment

Active prostheses

Bionic hand for 'elective amputation' patient

By Neil Bowdler
Science reporter, BBC News



Milo is measured up using his bionic hand prior to the operation

An Austrian man has voluntarily had his hand amputated so he can be fitted with a bionic limb.

The patient, called "Milo", aged 26, lost the use of his right hand in a motorcycle accident a decade ago.

Related

Bionic rev
gathers p

Static prostheses have poor compliance because they fail to deliver

Dynamic cosmesis

New generations of neuro-integrated motorised prostheses

Future of Hand Restoration

transplant & biodynamics

UK's first hand transplant operation

COMMENTS (243)

By James Gallagher
Health and science reporter, BBC News

Mark Cahill, right, can wiggle the fingers on his new hand

The University of Glasgow & Canniesburn

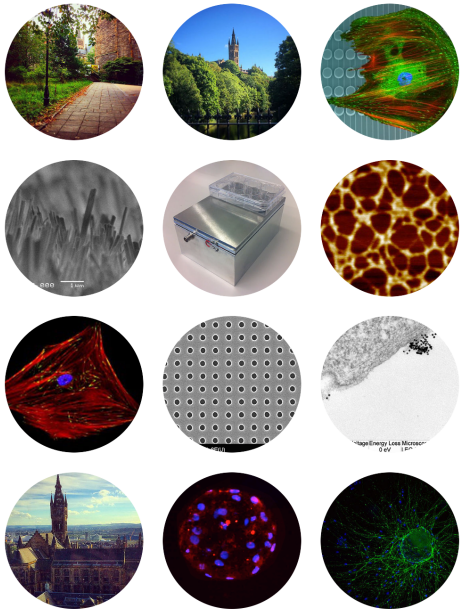
University of Glasgow

Welcome to CCE!

We are a multidisciplinary centre aiming to discover new stem and nerve cell technologies through use of nanoparticles and materials engineering. View our history here

Our History

Scroll through our website and other social media feeds to keep up to date.

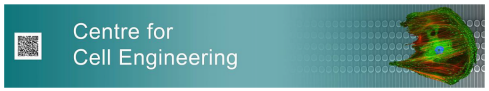


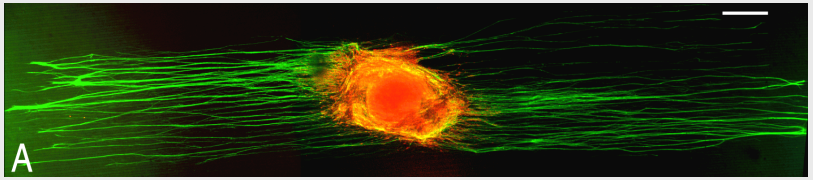
Professor Matt Dalby named as RSE Fellow

15th Feb 2017

Professor Matthew Dalby has been named an honorary fellow by the Royal Society of Edinburgh.

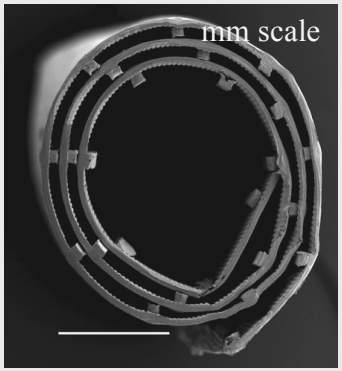
Press Release

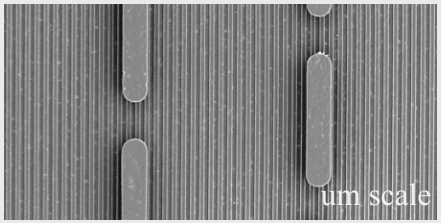


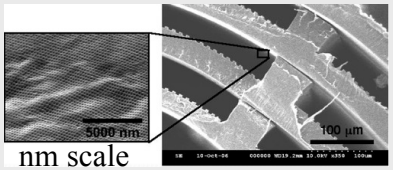


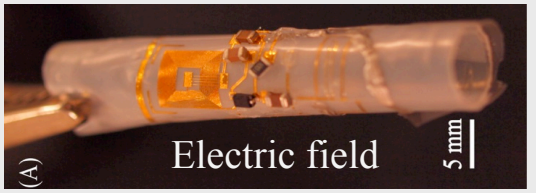
Pioneering synthetic bone project will help landmine victims

Sir Bobby Charlton, founder of the Find A Better Way charity, visits a mine clearance site in Battambang in Cambodia. Picture: Dimas Ardian/Getty



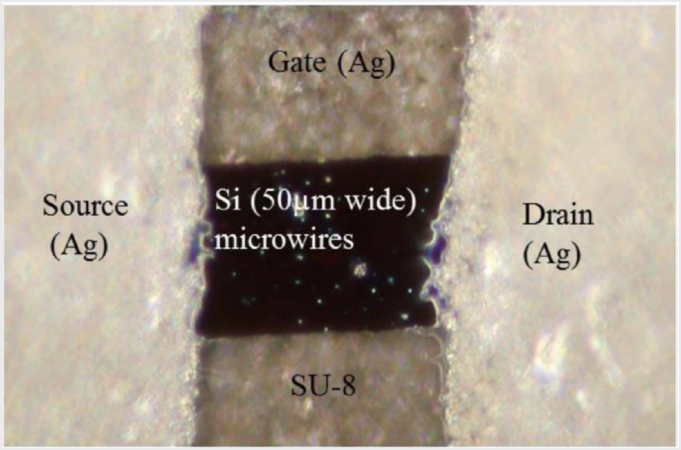


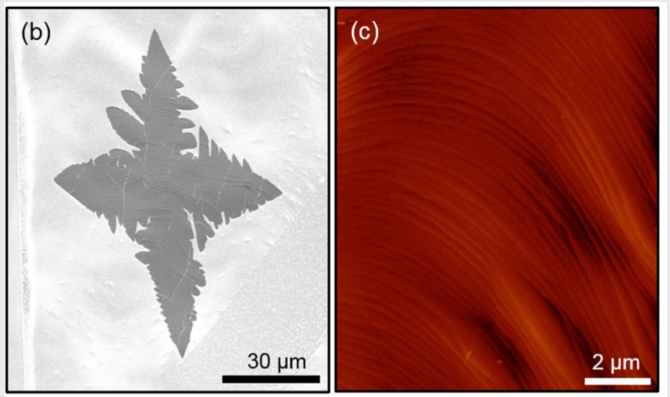




Prof. Ravinder Dahiya

Electronic skin & tactile sensing robotics





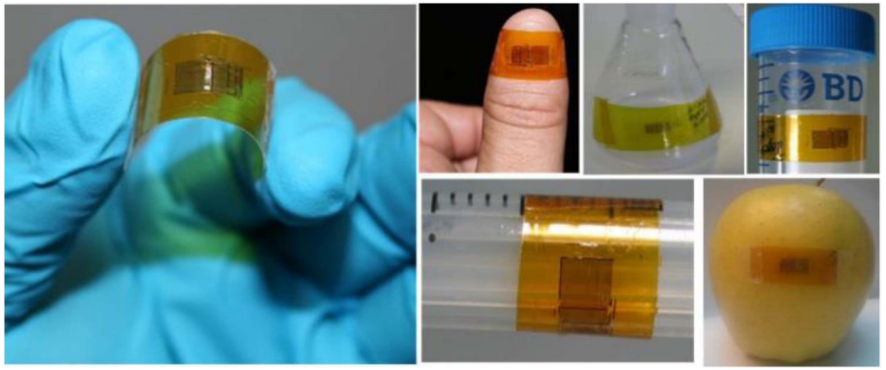


Figure 3. Transferred Si microwires on PI substrate and attached to various objects with different orientations and radius of curvatures.

Summary

Initial treatment, with early reconstruction, optimises outcome

Secondary reconstruction has a significant role in overall management

- include predictable options such as FFMT into initial careplan
- avoid procedures that obviate important secondary reconstructive options
- dynamic cosmesis + functional worth = psychological wellbeing

Key elements:

- Fusions: wrist & shoulder very effective in appropriate circumstances
- Reanimation: tendon transfers & muscle transfers
- Holistic care

Never too young, too old, or too late