Best Practice in Limb Reconstruction Surgery in the United Kingdom

November 2025

Section 1: Introduction and Definition

i. Limb reconstruction surgery (LRS) involves the management of a diverse group of congenital and acquired conditions. The goal of treatment is to improve limb function and quality of life by correcting limb deformity, reconstructing skeletal defects, managing long bone and fracture related infection (FRI), and fracture non-union. It may also involve ablative reconstruction or amputation surgery. Limb reconstruction is generally undertaken in specialist units, typically located in elective surgical sites and major trauma centres and with suitable support within a district general hospital.

ii. Decision-making is complex and management strategies include a spectrum of surgical techniques including implants, external fixators, and novel technologies. This is based on accepted principles and surgeon experience to inform individualised treatment, and it is common for a range of surgical strategies to be available to manage a particular condition.

iii. Treatment pathways should focus on collaborative working based on peer-review and recognised National or Regional Best Practice Guidelines/Consensus, rather than individual preferences and competence and this is particularly important when new techniques and interventions are being considered.

iv. Dual consultant operating, particularly in low volume high complexity cases (LVHC), is recommended to enhance patient safety and improve outcome.

v. Robust clinical governance ensures high standards of care and improvements in service quality, within an environment that promotes excellence in patient-centred care. This is often achieved by effective multi-disciplinary working.

vi. Whilst the vast majority of LRS is undertaken in the UK is based in the NHS, all the points discussed equally apply to practice in the private/independent sector.

Section 2: Patient Assessment and Surgical Decision-Making

i. The number of LRS procedures undertaken in the UK is lower than other orthopaedic specialities and includes LVHC cases, with high complexity defined as technically difficult or lengthy procedures, those requiring intra-operative decision-making, or those associated with a high risk of complications.

The treatment journey is often significantly longer than in other areas of orthopaedics and patients should be referred to units with a dedicated team including specialist nurses and allied health professionals (AHPs).

ii. Paediatric and Adult patients suitable for specialist review include:

- congenital limb deficiency and/or deformity
- acquired limb deformity and/or leg length discrepancy resulting from trauma, tumour, infection, inflammatory, or metabolic causes
- fracture non-union and mal-union
- FRI and osteomyelitis
- bone defect management
- trauma, including management of open fractures, multifragmentary fractures, and peri-articular fractures
- amputation, planned or secondary to trauma

iii. Limb reconstruction specialist techniques include:

- distraction histiogenesis for:
    - bone lengthening
    - deformity correction
- external fixators for definitive management of:
    - fractures
    - bone defects
    - limb length discrepancy
    - limb deformity
    - motorised internal nails including bone transport nails
    - acute correction of deformity and/or limb length equalisation by internal fixation
    - bespoke / custom implants
    - implants used beyond manufacturer or regulator indications

iv. Multispecialty working is frequently required, particularly in the following conditions:

- open fractures, and post traumatic deformity (Specialist trauma and plastic surgeons)
- FRI and osteomyelitis (Orthopaedic and plastic surgeons, microbiologist)
- lower limb malalignment, metabolic bone conditions, and skeletal dysplasias (Paediatric orthopaedic surgeons, paediatricians and physicians)
- periarticular knee deformity, osteoarthritis, and patella femoral instability (Specialist knee surgeons)
- foot and ankle deformity (Specialist foot and ankle surgeons)
- amputation (Physicians, prosthetists and specialist physiotherapists)

v. United Kingdom's General Medical Council (GMC) 'Good Clinical Practice (2024)' guidelines propose four domains that all doctors should:

a. maintain knowledge, skills and performance

b. maintain patient safety and quality of treatment

c. ensure good communication, partnership decision-making and teamworking inclusive of doctors and patients

d. maintain trust with honesty, openness and integrity

vi. A signature on a consent form in isolation is not sufficient and the decision to undertake treatment must also involve a comprehensive discussion between the patient and clinician including agreed outcome goals.

This should include the diagnosis, aetiology and natural history of the condition without treatment. The range of available interventions, including non-operative alternatives should be discussed and patients informed of the material risks associated with each option. Whenever possible, the incidence of each risk should be should estimated, informed by verifiable personal data and published results.

vii. This information should be recorded in the medical records with a patient's copy written to account for their reading age and first language.

viii. An interval between decision and formal consent provides an opportunity for reflection and further questions before proceeding with any planned treatment.

A consent form should be signed by:

- adults with capacity
- young adults aged 16-17 years with capacity
- Gillick competent children aged <16 years

- parents or legal guardians of children aged <16 who are not Gillick competent
- parents or legal guardians of young adults aged 16-17 who lack capacity
- legal guardians of adults who lack capacity

ix. Pre-operative assessment should involve all relevant members of the multi-disciplinary team to optimise the outcome. This should identify social constraints, plan post-operative mobilisation and functional joint rehabilitation, and enable assessment of patient well-being and vulnerability to the psychological impact of the treatment.

x. In the unconscious patient or where they lack capacity, treatment that is immediately necessary to save life or prevent a serious deterioration can be provided. If there is more than one treatment option, the choice should have the least impact on the patient's statutory rights and future choices. Open discussion with colleagues is recommended and an outcome review should be undertaken to confirm that reasonable treatment alternatives were discussed and an optimum result obtained. When capacity and sufficient comprehension is re-established, the patient must be informed what has been undertaken with an explanation and additional treatment options discussed.

Specialist Nature of LRS Procedures	Limb Reconstruction Surgery (LRS) often involve complex, high-risk procedures requiring intra-operative decision-making. Patients should be referred to dedicated multidisciplinary units.
Indications for Specialist Review	Patients require specialist input for conditions including limb deformity, fracture non-union, bone infections bone defects, complex trauma, and for amputation planning.
Consent and Pre-operative Assessment	Informed consent must involve detailed discussion of diagnosis, treatment options (including non-operative), risks, and expected outcomes. Documentation should be patient-friendly, allow time for reflection, and involve appropriate legal guardians where necessary. Pre-operative assessment should address social, psychological, and functional needs.

Section 3: Peer Review/MDT meetings

i. Best practice is that planned surgical cases are subject to peer review/ MDT meetings, to involve a discussion of the natural history of the case without (surgical) intervention, the management strategies available and the surgical options and techniques. This discussion should involve colleagues with experience of the management of the index condition. These reviews will usually be held at Trust level, but smaller units may need discussion between centres. This allows them to benefit from additional experience for discussion and in decision-making.

ii. Peer review/MDT meetings should be held regularly and timetabled within job plans. A format and structure for the meeting, including attendees, minimum numbers to be quorate, and method of documentation should be agreed within the Trust (or Network). Realistic and appropriate outcome measures should be agreed pre-op and confirmed at post-op meetings.

iii. A summary of the peer review/ MDT meeting outcome should be documented in the patient's notes and any relevant communications passed on to the patient, parents/guardians, GPs and all other health care professionals involved.

iv. To function efficiently, peer review/MDT meetings require a minimum attendance of experienced orthopaedic surgeons willing to engage and share knowledge and experience. It is recommended that a minimum number of consultants attend pre- and post- operative peer/ MDT meetings at least once a month.

Trusts must provide resources and time for multidisciplinary clinics with appropriate job planning to accommodate multi-specialist reviews.

Regular non-attendance should be identified by unit leads and actioned through annual appraisal.

v. At an individual level, surgeons should undertake robust data collection, including keeping complete logbooks or local registers, with the ability to track activity levels, procedures undertaken and complications. This data should be available for both appraisal and revalidation purposes, as well as for unit level review by commissioners and professional bodies.

vi. Multi-disciplinary discussion in advance of admission, should be conducted for conditions that are rare and for procedures that are technically difficult, require intraoperative decision-making, are lengthy, carry a high risk of complications, and are performed in small numbers.

This provides an opportunity for contributions from a range of clinical perspectives, with the potential to change management decisions in advance of a planned admission.

vii. Quarterly presentation of surgical outcomes will provide an early opportunity to identify an unexpected outcome, which should be reported to the host trust clinical director, to assess the need for further investigation.

viii. Local peer review/MDT meeting

- Essential members include:
  - consultant orthopaedic surgeons
  - clinical nurse specialists
  - specialist physiotherapists
- Additional members may include:
  - plastic surgeons trained in limb reconstruction techniques
  - specialist radiologists
  - microbiologist/ ID physicians
  - psychologists
  - psychiatrists
  - rehabilitation physicians
  - occupational therapists
  - orthotists
  - prosthetists
  - social workers
  - play specialists

Cases discussed should include:

a. all patients listed for planned surgery since the last meeting, to enable peer group discussion and confirmation of surgical decision-making. Further discussion may take place on additional aspects identified by the specialist nurses and AHPS

b. patients under a trauma pathway treated with limb reconstruction techniques

c. all post-operative cases since the last meeting with all complications highlighted

The meeting should also be a forum for:

d. forward planning to confirm theatre lists, implant provision and appropriate staffing for surgical support

e. collection of morbidity and mortality data and identification of trends for complications

f. formal audit of process with additional presentation at regular Trust Morbidity & Mortality meetings, with all other specialities

ix. Local bone infection peer review/MDT meeting

MDT working in FRI management improves the quality of care. Teams should develop their meetings to be in alignment with the principles outlined in the FRI International Consensus recommendations.

Essential members include:

- consultant orthopaedic surgeons trained in management of FRI and osteomyelitis
- consultant plastic surgeons
- consultant microbiologists/ ID physicians
- consultant radiologist
- specialist nurses including specialist tissue viability practitioners
- and specialist physiotherapists

x. Local paediatric deformity correction peer review/MDT meeting

Essential members include:

- paediatric orthopaedic surgeons
- paediatric specialist physiotherapists
- paediatric clinical nurse specialists
- orthotists
- prosthetists

xi. Local orthoplastics peer review/MDT meeting

Essential members include:

- orthopaedic surgeons
- plastic surgeons
- specialist physiotherapists
- clinical nurse specialists

xii. Trauma Meeting

Cases that require input from specialist limb reconstruction surgeons include the management of bone defects and patients with definitive treatment with an external fixator. The acute phase of these injuries may be overseen by surgeons trained in the generality of orthopaedics, but the definitive management should be performed by surgeons with sub-speciality training in limb reconstruction. Immediate support should be available from a team of limb reconstruction surgeons working cohesively within a single department.

Consultants working in isolation must collaborate with colleagues through a regionally based group of surgeons experienced in limb reconstruction techniques.

Discussion should be documented confirming treatment decision-making and surgical outcomes and complications should be presented at local and regional morbidity meetings.

xiii. Morbidity and mortality reviews

These should be conducted in line with Good Medical Practice and as part of the normal appraisal following local guidelines and process. Due to the complexity of the cases in LRS, morbidity and mortality discussions should be conducted as part of the wider routine peer reviews of cases recommended above. Morbidity and mortality should be recorded both for the individual surgeon and at a unit level.

xiv. Dual consultant operating

Dual consultant operating is necessary because of an increasingly complex case-mix, the changing nature of surgical training, and the experience of newly appointed orthopaedic consultants. The decision to undertake a dual operating will be made by individual consultants, based on experience and surgical need. This should be acknowledged at Trust level and with supported by flexible job planning.

The advantages include:

- increasing individual surgical experience and numbers of cases
- guaranteed skilled assistance
- mentorship and support of newly appointed limb reconstruction surgeons
- improved intra-operative surgical decision-making through collaboration
- improved outcomes
- enhanced training experience for trainees and fellows
- safe introduction of novel techniques

Peer Review/MDT meetings Key Points

Peer Review/MDT Meetings	All planned surgical cases should undergo peer review or MDT discussion to evaluate management strategies and surgical options. These meetings should involve experienced colleagues and may require collaboration between centres.
Structure and Documentation	MDT meetings must be scheduled regularly, with agreed formats, minimum attendance, and clear documentation of outcomes. Meeting summaries should be recorded in patient notes and communicated to all relevant parties, including patients and healthcare professionals.
Data Collection and Outcome Monitoring	Surgeons should maintain comprehensive logbooks for appraisal and revalidation. Presentation of outcomes at regular morbidity/mortality review meetings are required to identify complications early and ensure continuous quality improvement.
Dual Consultant Operating	Dual consultant operating is recommended in selected cases to improve decision-making, mentorship, training, and patient outcomes.

Section 4: Ensuring Competency

i. Level of training

A Limb Reconstruction surgeon should:

- have completed higher surgical orthopaedic training that ideally includes an attachment on a limb reconstruction team
- have passed the FRCS (Orth) examination, or equivalent
- be eligible for inclusion on the Specialist Register

Candidates for a consultancy in limb reconstruction should have also undertaken recognised fellowship level training in Limb Reconstruction techniques, appropriate for the position.

To ensure a cohesive and well-functioning unit, the appointments board must confirm that candidates provide evidence of:

- experience of pre- and post-operative multidisciplinary working and case review
- an understanding of these processes
- the importance of inter-personal relationships

ii. Maintenance of competency

All consultants must undertake an annual appraisal and regular revalidation, which includes local trust mandatory training.

Shared learning and decision-making is essential when dealing with low volume high complexity conditions and appraisal should therefore focus on multidisciplinary working and interpersonal relationships with colleagues.

Human Resource departments should have a robust process for the prompt recognition and management of interpersonal disputes, initially by mediation with appropriate escalation as required.

It is essential that there is adequate time in consultant job plans for personal audit and data collection.

Pre- and post-operative patient outcomes should be presented at local and regional meetings (see above) and available for discussion at annual appraisal.

Competency is also enhanced by activities, including local teaching, faculty on regional, national and international courses, and as part of regional and national peer review groups. This should be a recognised component of a consultant's job plan.

iii. Membership of a Specialist Society

It is recommended that orthopaedic consultants who undertake limb reconstruction surgery should be members of a specialist limb reconstruction society and be able to frequently attend the annual conference and/or the limb reconstruction section of an annual national orthopaedic congress.

Attendance at these meetings facilitates continued professional development and enables discussion with a wider network of specialist surgeons, both nationally and internationally and this should be supported with appropriate study leave and budget.

iv. Multiprofessional teamwork

Multiprofessional teamwork results in better outcomes and is considered essential in the care of limb reconstruction patients. Clinical nurse specialists (CNS), specialist physiotherapists (Sp PT), extended scope Allied Health professionals (AHP), and Advanced Clinical Practitioners (ACP) are crucial members of a limb reconstruction team and work within agreed competencies to ensure holistic care during a complex treatment journey.

These extended roles include clinical care, patient education, coordination, research, and service development. This is achieved by practitioners applying a high level of clinical knowledge, covering both technical and soft skills, as well as educating and supporting staff working. The scope of practice will depend on an individual's postgraduate qualifications and level of training, and each practitioner will be accountable to their line managers, service leads, and professional bodies.

Limb Reconstruction specialist physiotherapy input is recommended by national limb reconstruction guidance and improves rehabilitation consistency across the care pathway.

Rehabilitation of patients after traumatic injury NICE guidance NG211. (2022) defines the roles of CNS and AHP members of the limb reconstruction rehabilitation team. The remit of technical skills includes but is not limited to:

- patient and family / carer education
- care co-ordination
- clinical care within scope of practice / protocol)
- advanced assessment and decision-making
- pain and symptom management

Ensuring Competency Key Points

Training and Qualifications	Limb Reconstruction surgeons should have completed higher orthopaedic surgical training that ideally includes an attachment on a limb reconstruction team, have passed the FRCS (Orth) examination, or equivalent, be eligible for inclusion on the Specialist Register, and have undertaken a recognised fellowship in limb reconstruction techniques. Appointment boards should confirm experience in multidisciplinary working and strong interpersonal skills.
Maintenance of Competency	Annual appraisal, revalidation, and mandatory training are essential and must be supported by job planning. Competency is maintained by shared learning, robust data collection, regular presentation of outcomes, and involvement in teaching and peer review activities.
Professional Development and Society Membership	Surgeons should be members of a specialist limb reconstruction society and attend national/international conferences for continued professional development. Attendance should be supported by study leave and budget allocation.
Multiprofessional Teamwork	Effective care requires collaboration between professional groups to provide clinical care, patient education, coordination, research, and service development.

Section 5: Innovation

i. Robust processes must be in place to evaluate the safety and efficacy of new techniques and implants and reporting of adverse outcomes and complications is essential.

Patients must be informed of the intention to use a novel technique or implant during the consent process. The benefits and risks should be discussed, including alternative treatment options.

Hospital trusts should be informed in writing of the intention to new technique or device.

The implant should be presented at an innovation and new implant committee.

In the absence of high-quality evidence, new procedures or implants should be used as part of a formal research project, with regular audit and review recorded within the trial protocol and departmental MDT meeting.

Any adverse events or clinical concerns must be reported to the Medicines and Healthcare products Regulatory Agency (MHRA) and the implant manufacturer.

Governance and Safety for New Techniques	Robust processes must evaluate the safety and efficacy of new techniques and implants, with mandatory reporting of adverse outcomes to MHRA and manufacturers. Hospital trusts must be informed in writing, and new implants should be presented to an innovation and new implant committee.
Patient Consent and Research Oversight	Patients must be informed during consent about the use of novel techniques or implants, including benefits, risks, and alternatives. In the absence of strong evidence, new procedures should be part of a formal research project with regular audits and MDT reviews documented in the trial protocol.

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