

Title: Standards for treatment of open lower limb fractures maintained in spite of the COVID-19 pandemic: results from an international, multi-centric, retrospective cohort study.

Authors: Juan Enrique Berner MD, MSc, MRCS^{1,2}; James K-K Chan^{3,4} MA, DPhil, FRCS(Plast); Matthew D. Gardiner^{5,6} MA, PhD, FRCS(Plast); Hinne Rakhorst⁷ MD, PhD; Alina Ortega-Briones⁸ MD, FEBOT; RSTN COVID - INTELLECT Collaborative†; Jagdeep Nanchahal⁶ PhD, MBBS, FRCS(Plast); and Abhilash Jain⁴ MBBS, MSc, PhD, FRCS(Plast).

Affiliations:

1. Department of Plastic Surgery, The Newcastle upon Tyne Hospitals NHS Foundation Trust. Queen Victoria Rd., Newcastle upon Tyne, NE1 4LP, UK
2. Kellogg College, University of Oxford. 60-62 Banbury Rd, Oxford, OX2 6PN, UK
3. Department of Plastic Surgery, Stoke Mandeville Hospital. Mandeville Rd, Aylesbury, HP21 8AL, UK.
4. Nuffield Department of Orthopaedics, Rheumatology and Musculoskeletal Sciences, University of Oxford. Roosevelt Drive, Oxford, OX3 7FY, UK
5. Department of Plastic and Reconstructive Surgery, Wexham Park Hospital. Slough, SL2 4HL, UK
6. The Kennedy Institute of Rheumatology. Nuffield Department of Orthopaedic, Rheumatology and Musculoskeletal Sciences, University of Oxford. Oxford, OX3 7FY, UK
7. Plastic and Reconstructive Surgery Department, Medisch Spectrum Twente. Enschede, The Netherlands.
8. Trauma and Orthopaedic Surgery Department, Hospital San José Quirónsalud. Madrid, Spain

Corresponding author:

Mr Juan Enrique Berner MD, MSc (Oxon), MRCS

Royal Victoria Infirmary. Queen Victoria Rd, Newcastle upon Tyne, NE1 4LP

Email: juan.berner@kellogg.ox.ac.uk

Telephone: 01912336161

Word count:

† RSTN COVID - INTELLECT Collaborative investigators:

Hospital del Trabajador de Santiago (Chile): Nicolás **Pereira**, Gonzalo **Bastías**, Josefa **Venegas**

Imperial College Healthcare NHS Trust (UK): Harsh **Samarendra**

Ribat University Hospital (Sudan): Hassan **Elbahari**, Hytham K. S. **Hamid**

Norfolk and Norwich University Hospitals NHS Foundation Trust (UK): Samuel **Norton**, George **Lafford**, Joshua **Thompson**

The Hull University Teaching Hospitals NHS Trust (UK): Cher Bing **Chuo**, Chie **Katsura**

Hospital Universitario de Gran Canaria "Doctor Negrín" (Spain): Mónica **Frances Monasterio**, Ivan **Beirutti**, Jose Miguel **Casarrubios Barrera**

Dalin Tzu Chi Medical Center (Taiwan): Honda **Hsu**

Medisch Spectrum Twente (The Netherlands): Kamilcan **Oflazoglu**, Iris **Beijk**

South Tees Hospitals NHS Foundation Trust (UK): William **Eardley**, Anthony **Egglesstone**

Asan Medical Centre, University of Ulsan (South Korea): Joon Pio **Hong**, Jin Geun **Kwon**

Hospital Clínico Universitario "Virgen de Arrixaca" (Spain): Javier **Martínez Ros**, Ana **Ortega Columbrans**

Ibrahim Malik Teaching Hospital (Sudan): Ahmed **Abugarja**, Mohamed **Awadelkarim**

Hospital General "Dr. Manuel Gea González" (Mexico): Eric **Santamaria**, Sergio **Vallejo**

Università degli Studi dell'Insubria (Italy): Mario **Cherubino**, Leonardo **Garutti**

Salisbury NHS Foundation Trust (UK): Marios **Nicolaou**, Jack **Pearce**, Terry-Ann **Curran**

Pontificia Universidad Católica de Chile (Chile): Alfonso **Navia**, Rodrigo **Tejos**

The COVID-19 pandemic has severely disrupted provision of healthcare services, impacting both emergency and elective pathways¹. In March 2020, the British Orthopaedic Association in conjunction with other relevant bodies published guidance for the treatment of limb-threatening injuries during the pandemic². These were designed to minimise the risks of patients contracting COVID-19 from prolonged inpatient stay and reduce the burden on stretched health services. They recommended that multiple and complex procedures should be avoided and the threshold for early amputation reduced.

The aim of this study was to assess the safety of care pathways for patients sustaining open extremity injuries during the first wave of the COVID-19 pandemic. Our primary objective was to investigate the risk of SARS-CoV-2 related complications in this group of patients, including death. As a secondary objective we intended to capture deviations from the standard of care usually provided for these injuries and associated outcomes. Given the burden of trauma in developing countries even before the pandemic, we examined the impact on a global scale.

Methodology

We conducted an international, multi-centric, retrospective study in patients with open lower limb fractures, of any severity, treated between the 1st January and 31st May 2020. Participating units in the UK and overseas provided anonymised data using a pre-established proforma on a secure REDCap platform. Approval by clinical audit departments and independent board review in each collaborating hospital was sought as per local protocols.

Results

A total of 212 patients from 15 centres in the United Kingdom (36%), Chile (20%), Sudan (14%), Spain (10%), the Netherlands (6%), Taiwan (5%), South Korea (5%), Mexico (2%) and Italy (2%) were included. Demographic data, injury characteristics, treatment received, and inpatient recovery were recorded (Table 1).

Despite the pandemic, all centres treated patients according to their usual standards with minimal deviation. Seven patients (3.3%) had their follow-up appointments delayed or adapted to telephone consultations. The majority underwent debridement in the first 24 hours (73%). Median time to definitive skeletal fixation and soft tissue reconstruction, if required, from time of injury was two and ten days, respectively. Limbs preservation at discharge was achieved in 94.4% of the cases, with 12 patients (5.6%) requiring immediate or early amputation. Serious complications included three total (6%) and five partial flap failures (10%), 10 cases of acute wound infection (5%), two hematomas that required evacuation (1%) and two deep venous thrombosis (1%). Three patients in the flap failure group required further reconstruction: two with a local flap and one with a second free flap. Two patients in this cohort died because of their injuries and two succumbed to hospital acquired non-COVID pneumonias in the context of pre-existing COPD. No patients were diagnosed with SARS-CoV-2 prior to admission and only one tested positive as an inpatient (0.5%) on PCR and CT-scans and eventually made a full recovery.

Discussion

Even though there have not been any previous international studies of these characteristics, there are large cohort series published. For the UK subgroup, three of 79 patients (3.7%) required amputation which is similar to the recent UK WOLFF trial (2% of 460 cases)⁴. Partial and total free flap failure rates (6.8% for both) are also similar to those reported by a recent study of 129 patients treated in the United States, which reported 10.8% partial and 14.7% total flap failure, and 7.8% requiring amputation⁵.

Our study is limited by its retrospective nature, geographic variability, different resource settings and limited follow up (1 to 105 days). This design was necessary to achieve a rapid and global response during the ongoing COVID-19 pandemic. The incidence of patients with COVID-19 in this international sample of emergency admissions was very low. Despite guidance advocating the avoidance of staged procedures and limb salvage in borderline situations, almost all patients received standard care.

Our data demonstrate that lower limb trauma services across many countries have managed to adhere to their usual pre-COVID standard of care⁶. The outcomes so far have remained largely

within modern acceptable outcomes. Provided standard surgical COVID-19 precautions are maintained, including screening patients with unknown COVID status upon admission, and routine use of personal protective equipment, it would be reasonable to follow pre-COVID guidance and expect similar outcomes during the current second wave of the pandemic.

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A protocol for this study has been submitted for publication as part of the RSTN-COVID group.

Disclosure

All the authors deny any conflicts of interest

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Table 1: Data gathered for cases submitted to the INTELLECT-COVID study. The second column presents results for the whole sample, with the following columns presenting national results for countries that represent 80% of included cases

Demographics	Total (n=212)	UK (n=79)	Chile (n=42)	Sudan (n=29)	Spain (n=21)
Mean age	46 years (range: 6-98)	47 years	38 years	35 years	52 years
Male : Female	74:26	70:30	83:17	93:7	62:38
Location of fracture	Femur: 15% / Tibia-fibula: 69% / Foot: 16%	Femur: 10% / Tibia-fibula: 77% / Foot: 13%	Femur: 45% / Tibia-fibula: 31% / Foot: 24%	Femur: 0% / Tibia-fibula: 85% / Foot: 15%	Femur: 10% / Tibia-fibula: 76% / Foot: 14%
Mechanism of injury	Road traffic accident: 54% / Low-energy fall: 19% / High-energy fall: 12% / Work-related: 11% / Other: 4%	Road traffic accident: 39% / Low-energy fall: 35% / High-energy fall: 18% / Work-related: 5% / Other: 3%	Road traffic accident: 64% / Low-energy fall: 0% / High-energy fall: 6% / Work-related: 25% / Other: 5%	Road traffic accident: 80% / Low-energy fall: 4% / High-energy fall: 0% / Work-related: 4% / Other: 12%	Road traffic accident: 38% / Low-energy fall: 33% / High-energy fall: 24% / Work-related: 5% / Other: 0%
Fracture classification (Gustilo-Anderson)	I: 20% / II: 37% / III A: 17%, B: 21%, C: 5%	I: 19% / II: 27% / III A: 13%, B: 38%, C: 3%	I: 18% / II: 66% / III A: 16%, B: 0%, C: 0%	I: 22% / II: 39% / III A: 14%, B: 22%, C: 3%	I: 24% / II: 37% / III A: 24%, B: 5%, C: 10%
Treatment and outcomes					
Direct transfer to specialist centre	76%	80%	76%	62%	86%
Wound debridement within 24 hours	77% / Median time to debridement: 11 hours	72.2% / Median time to debridement: 20 hours	93% / Median time to debridement: 5 hours	66% / Median time to debridement: 10 hours	86% / Median time to debridement: 9 hours
Specialties involved in primary debridement	Orthopaedic surgeons: 64% / Plastic surgeons: 24.2% / Orthopaedic and plastic surgeons: 6.6% / Trauma surgeons: 5.2%	Orthopaedic surgeons: 34% / Plastic surgeons: 53% / Orthopaedic and plastic surgeons: 13% / Trauma surgeons: 0%	Orthopaedic surgeons: 95% / Plastic surgeons: 5% / Orthopaedic and plastic surgeons: 0% / Trauma surgeons: 0%	Orthopaedic surgeons: 86% / Plastic surgeons: 14% / Orthopaedic and plastic surgeons: 0% / Trauma surgeons: 0%	Orthopaedic surgeons: 95% / Plastic surgeons: 5% / Orthopaedic and plastic surgeons: 0% / Trauma surgeons: 0%
Median time to definitive skeletal fixation	2 days	1 day	1 day	4 days	5 days
Primary mode of definitive skeletal fixation	Casting: 5% / Uni-biplanar external fixator: 5% / Frame external fixator: 17% / Plate and screws: 32% / Intramedullary nail: 29% / Kirschner wires: 4% / Other:	Casting: 8% / Uni-biplanar external fixator: 3% / Frame external fixator: 19% / Plate and screws: 23% / Intramedullary nail: 39% / Kirschner wires: 3% / Other: 5%	Casting: 0% / Uni-biplanar external fixator: 3% / Frame external fixator: 0% / Plate and screws: 52% / Intramedullary nail: 26% / Kirschner wires: 0% / Other: 19%	Casting: 10% / Uni-biplanar external fixator: 0% / Frame external fixator: 48% / Plate and screws: 14% / Intramedullary nail: 14% / Kirschner wires: 14% / Other: 0%	Casting: 5% / Uni-biplanar external fixator: 24% / Frame external fixator: 24% / Plate and screws: 24% / Intramedullary nail: 5% / Kirschner wires: 5% / Other: 13%

	8%				
Soft tissue reconstruction required	36%	51%	19%	21%	19%
Median time to soft tissue closure	10 days	4 days	29 days	37 days	35 days
Modality of soft tissue closure (Total n=76)	Conventional dressings: 3% / Negative pressure wound therapy: 5% / Skin grafting: 16% / Local flaps: 10% / Perforator flaps: 22% / Free flaps: 44%	Conventional dressings: 3% / Negative pressure wound therapy: 8% / Skin grafting: 13% / Local flaps: 11% / Perforator flaps: 21% / Free flaps: 45%	Conventional dressings: 0% / Negative pressure wound therapy: 0% / Skin grafting: 25% / Local flaps: 13% / Perforator flaps: 13% / Free flaps: 50%	Conventional dressings: 20% / Negative pressure wound therapy: 0% / Skin grafting: 40% / Local flaps: 20% / Perforator flaps: 20% / Free flaps: 0%	Conventional dressings: 0% / Negative pressure wound therapy: 0% / Skin grafting: 0% / Local flaps: 33% / Perforator flaps: 66% / Free flaps: 0%
Flap survival rates	Local and perforator flaps (n=20): Total flap failure 5% / Partial flap failure: 10% / Total flap survival: 85%. Free flaps (n=29): Total flap failure 6.8% / Partial flap failure: 6.8% / Total flap survival: 86.2%.				
Unexpected return to theatre in first 30 days	8%	9%	0%	10%	5%
Amputation	Immediate: 1.4% / Early: 4.3%	Immediate: 1.2% / Early: 2.5%	Immediate: 0% / Early: 4.7%	Immediate: 3.4% / Early: 3.4%	Immediate: 0% / Early: 0%
Median time to discharge	13 days	14 days	10 days	6 days	11 days
Patients diagnosed with COVID pre-admission	0				
Patients diagnosed with COVID during admission	1 (0.47%)				
Missing data 0.83%					