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The theoretical impact on corrective upper limb elective services following analysis of distal radius fractures managed nonoperatively during COVID-19 pandemic

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Aims

To assess the proportion of patients with distal radius fractures (DRFs) who were managed nonoperatively during the COVID-19 pandemic in accordance with the British Orthopaedic Association BOAST COVID-19 guidelines, who would have otherwise been considered for an operative intervention.

Methods

We retrospectively reviewed the radiographs and clinical notes of all patients with DRFs managed nonoperatively, following the publication of the BOAST COVID-19 guidelines on the management of urgent trauma between 26 March and 18 May 2020. Radiological parameters including radial height, radial inclination, intra-articular step-off, and volar tilt from post-reduction or post-application of cast radiographs were measured. The assumption was that if one radiological parameter exceeds the acceptable criteria, the patient would have been considered for an operative intervention in pre-COVID times.

Results

Overall, 92 patients formed the cohort of this study with a mean age of 66 years (21 to 96); 84% (n = 77) were female and 16% (n = 15) were male. In total, 54% (n = 50) of patients met at least one radiological indication for operative intervention with a mean age of 68 years (21 to 96). Of these, 42% (n = 21) were aged < 65 years and 58% (29) were aged ≥ 65 years.

Conclusion

More than half of all DRFs managed nonoperatively during the COVID-19 pandemic had at least one radiological indication to be considered for operative management pre-COVID. We anticipate a proportion of these cases will require corrective surgery in the future, which increases the load on corrective upper limb elective services. This should be accounted for when planning an exit strategy and the restart of elective surgery services.

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Introduction

Distal radius fractures (DRF) are one of the most common fractures in adults. Around 6% of all women will have a DRF by the age of 80 years increasing to 9% by the age of 90 years.[1] It results from either a high energy injury affecting younger patients or a low energy injury in the elderly, related to osteoporosis.[2] Operative and nonoperative methods in the management of DRFs are widely accepted, with the choice being guided by the fracture configuration, radiological parameters, and patient factors.[3-5] Nonoperative management of DRFs include closed reduction and application of an immobilization tool such as a plaster cast or an orthotic splint to maintain an acceptable anatomical alignment.[3,5,6] Operative management of unstable DRFs

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Table I. Summary of all distal radius fractures for our cohort, all managed nonoperatively.

Group, n (%)	All patients	< 65 yrs	≥ 65 yrs
Total	92 (100)	42 (46)	50 (54)
Male	15 (16)	9 (10)	6 (6)
Female	77 (84)	33 (36)	44 (48)
Right	34 (37)	15 (16)	19 (21)
Left	58 (63)	27 (29)	31 (34)

include Kirschner-wires or an open reduction internal fixation with plates and screws.[5,6] The success of nonoperative management to maintain a DRF alignment depends on several radiological parameters after manipulation and application of a plaster cast which, if exceeded, could constitute an indication for operative intervention.[6-8] These radiological parameters include radial height, radial inclination and intra-articular step-off on the posteroanterior (PA) view as well as volar tilt on the lateral view of the radiograph.[4,6-8]

The British Orthopaedic Association (BOA) published guidance on the management of patients with urgent orthopaedic conditions and trauma during the COVID-19 pandemic on the 24 March 2020 (BOAST COVID-19 guidelines).[9] The recommendations were that DRFs could be managed nonoperatively, accepting that for some patients, complications arising in the future will necessitate corrective surgery.[9] Nonoperatively managed DRFs with poor radiological alignment have an increased risk of radial shortening and malunion leading to radioulnar variance disturbance and triangular fibrocartilage complex disarrangement.[10,11] These complications, if not treated appropriately, can lead to a positive ulna variance with limited pronation and supination affecting the patients function negatively, ultimately requiring corrective surgery.[10,11]

As the UK passes the peak of the COVID-19 pandemic, efforts are being directed towards the safe restart of elective services, with an aim for 90% of elective workload to be reinstated by October 2020.[12,13] Our assumption was that there may be an increase in corrective elective upper limb workload, to manage complications arising from nonoperatively managed DRFs during the peak of the COVID-19. This increase in workload needs to be captured and factored into funding, planning, and capacity building strategies to restart elective services. Therefore, the aim of our study was to assess the proportion of patients with nonoperatively managed DRFs during the COVID-19 pandemic, in accordance with the BOAST COVID-19 guidelines, who would have otherwise been considered for operative intervention.

Methods

This was a retrospective study that evaluated all patients with DRFs managed nonoperatively between 26th March and 18th May 2020. As a service evaluation project, formal ethical approval was deemed not to be required. The study was registered and approved by the Trust' audit department. Wrist radiographs from two district general hospitals were retrieved from the Picture Archiving and Communication Systems (PACS) v. 3.2, following the publication of the BOAST COVID-19 guidelines on 24 March 2020. Standardized positioning of neutral forearm rotation was adopted for both the PA and lateral views. The radiographs were correlated with clinical and demographic data by reviewing clinical letters. Exclusion criteria were open DRFs, pathological DRFs, evidence of a previous DRF on the affected side, and patients with concomitant ulna shaft fractures. All patients who met the inclusion criteria during that period were managed in a plaster-of-Paris or a removable soft cast for six weeks, patients were referred to physiotherapy services for remote therapy.

Radiographic parameter measurements. Two independent orthopaedic registrars reviewed each radiograph post-reduction or post-application of a cast. Measurements of radial height; radial inclination, intra-articular step-off, and volar tilt were taken. The radial height was defined as the difference in length between the ulnar head and the distal end of the radial styloid on the PA view, measured in millimetres (mm). Radial inclination was defined as the angle between the articular surface of the distal radius and the radial styloid on the PA view, measured in degrees. Intra-articular step-off was defined as the articular displacement at the radiocarpal joint on the PA view, measured in millimetres (mm). Volar tilt was defined as the angle between the articular surface of the distal radius and a line drawn perpendicular to the anatomical axis of the radius measured in degrees, to the nearest decimal point, on the lateral views. Dorsal angulation of the DRF was set as a negative volar tilt.

Criteria for operative intervention pre-COVID-19. The radiological criteria set for consideration for operative intervention was:[6,14,15] > 5 mm shortening in radial height with the normal radial height set as 13 mm; > 5° of change in radial inclination with the normal radial inclination set at 23°; > 2 mm intra-articular step-off with a congruous distal radius articular surface set as the norm; and > -5° of volar tilt with the normal volar tilt set as 11°. Age related sub-group analysis of patients was carried out based on the BOAST guidelines on management of DRFs.[4] Patients were therefore divided into two-sub-groups, those below 65 years of age and those that are 65 years and older.

Statistical analysis. Inter-observer reliability was assessed using intraclass r (ICC) estimates and their 95% confident intervals. This was calculated using SPSS v. 26 (SPSS, Chicago, Illinois, USA) based on a single measurement, mean rating, absolute-agreement, and a two-way random effect model.

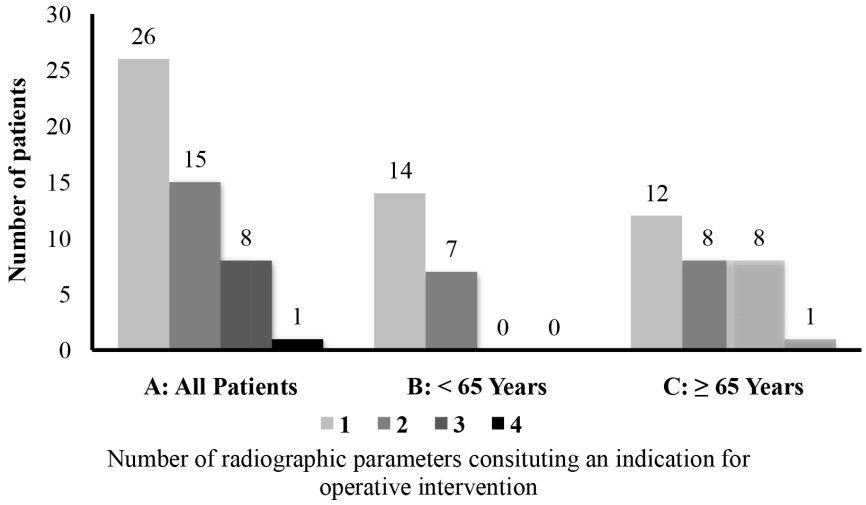

Fig. 1

Number of radiological parameters per patient that constituted an indication for operative intervention.

Table II. Age-related subgroup (proportion of patients with radiological parameters outside of acceptable range in each category).

Parameters, n (%)	All patients	< 65 yrs	≥ 65 yrs
Total	50	21	29
Radial height (>5 mm change)	23 (46)	5 (23)	18 (62)
Radial inclination (>5° change)	21 (42)	8 (38)	13 (45)
Volar tilt (>-5° change)	34 (68)	12 (57)	22 (76)
Intra-articular step (>2 mm)	5 (10)	1 (5)	4 (14)

Results

In total, 92 patients met our inclusion criteria and constituted to the cohort of our study. The mean age was 66 years (21 to 96); 84%(n = 77) were female and 16% (n = 15) were male. Of these, 37% (n = 34) and 63% (n = 58) had a right and left DRF respectively. These are summarized in Table I.

A total of 54% (n = 50) met at least one radiological indication for operative intervention. The number of radiological parameters per patient, that constituted an indication for operative intervention is shown in Figure 1. In this group, the mean age was 68 years (21 to 96), and 32% (n = 15) had a right DRF while 68% (n = 32) had a left DRF. The most prevalent in this group was a dorsally displaced DRF, accounting for 72% of patients who met criteria for operative intervention.

Overall, 46% (n = 23) met the criterion for an operative intervention due to a change in radial height of > 5 mm with a mean of 7 mm (8 to 18), while 42% (n = 21) met the criterion for an operative intervention due to an unacceptable radial inclination with a mean change of 20° (6° to 35°). A total of 68% (n = 34) had > -5° change in volar tilt with a mean change of -7° (-27° to 34°). Intra-articular step-off > 2 mm was seen in 10% (n = 5) of the patients.

A total of 42% (n = 21) with a radiological indication for operative intervention were aged < 65 years old. The mean age in this sub-group was 51 years (21 to 64) and 23% (n = 5) had a > 5 mm change in radial height, 38% (n = 8) had > 5° change in radial inclination, 57% had > -5° change in volar tilt, and 5% (n = 1) had an intra-articular step-off > 2 mm.

Overall, 58% (29) with a radiological indication for operative intervention were aged ≥ 65 years. The mean age in this sub-group was 80 years (67 to 96); 62% (n = 18) had > 5 mm change in radial height, 45% (n = 13) had > 5° change in radial inclination, 76% (n = 22) had > -5° change in volar tilt, and 14% (n = 4) had an intra-articular step-off > 2 mm. These results are summarized in Table II.

All radiological measurements had an acceptable interobserver correlation. The ICC for radial inclination was 0.514 (95% CI -0.22 to 0.81), radial height was 0.938 (95% CI 0.87 to 0.97), volar tilt was 0.525 (95% CI -0.21 to 0.81) and intra-articular step was 0.352 (95% CI -0.43 to 0.72).

Discussion

More than half (54%, n= 50) of all patients with DRFs managed nonoperatively during the pandemic had at least one radiological parameter that would have constituted an indication for operative intervention pre-COVID-19. This is considerably higher than previously reported rate in pre-Covid times of around 36%.[16] We therefore anticipate a large proportion of these patients to re-present to the orthopaedic elective services with poor functional outcomes, with a significant proportion of them requiring corrective surgery in the near future.

In our study, we found 58% of patients with DRFs aged ≥ 65 years had at least one radiological parameter, which would have constituted an indication for operative intervention. Although there's no direct correlation between radiological parameters in DRFs and the risk of corrective osteotomy in the future, worsening volar tilt and a positive ulnar variance in non-operatively managed DRFs,

are associated with worse functional outcomes in the elderly.[17] Higher rates of osteotomies have been reported in nonoperative compared with operatively managed DRFs, particularly in patients aged > 50 years.[18] Furthermore, nonoperatively managed DRFs in elderly patients with a radial shortening > 4.7 mm has been associated with persistent wrist pain at 23 months post-injury.[19] Although not universally applicable in the elderly population, patients with poor functional outcomes related to malunion would require a corrective osteotomy to restore the wrist range of movement and function. Operative restoration of radial height and intra-articular congruency were found to positively correlate with functional outcomes at mean a follow-up of 38 months.[20]

In our study, 42% (n = 21) of patients with DRFs aged < 65 years had at least one radiological parameter, which would have constituted an indication for operative intervention. Younger patients have a higher functional requirement and less comorbidity compared to older patients. Articular congruency has been associated with improved functional outcomes in young patients with intra-articular DRFs.[21,22]

More importantly, DRFs with an articular step-off greater than 2 mm, who were managed with a cast alone were noted to have a loss of reduction at subsequent follow-ups, with an increasing rate of malunion and associated poor functional outcomes.[21] In our cohort, 5% of patients < 65 years had an articular step-off of more than 2 mm. This group of patients would require close monitoring, regular follow-up with a portion of them potentially requiring corrective surgery in the near future, increasing the load on the upper limb elective services.

As the guidance for nonoperative management of most upper limb fractures was a national approach during the first peak of the COVID-19 pandemic; it is essential for working groups developing an exit strategy for the commencement of elective orthopaedic work to build sufficient capacity for an increase in elective upper limb services. An example of measures that we have adopted, is a consultant-led open access video clinic for all patients with injures that were managed during the peak of the COVID-19 pandemic. Patients can either self-refer or be referred by their GP into this clinic for a consultation and assessment. This should be done in conjunction with an increase in the number of face-to-face outpatient clinics and theatre sessions for elective upper limb surgery; to identify, assess and manage this group as well as to reduce the waiting list for elective upper limb cases. Appropriate additional funding should also be factored in to support such activities in addition to the resumption of upper limb elective services.

Limitations in our study include the absence of data on follow-ups in patients managed nonoperatively during the first peak of COVID-19. To reduce the risk of COVID-19 exposure within hospitals, these patients were asked not to attend regular follow-ups unless they experience immediate complications such as pain or cast related issues. We are, however, aware that DRFs that initially show an acceptable radiological alignment following reduction and immobilization can displace on subsequent follow-up radiographs.[23] This may, therefore, underestimate the overall proportion of patients who would have required an operative intervention, hence measures to increase capacity to allow close follow-up and appropriate management of these patients is paramount to any exist strategy. We recognize that elderly patients may have lower functional requirements and are likely to be poor surgical candidates due to multiple co-morbidities, thus, may be over-represented in our study. In order to understand the true impact on the elective upper limb services in the near future, a follow-up study of the functional outcomes in this cohort should be conducted in 12 months' time.

The COVID-19 pandemic presented an unprecedented situation requiring pragmatism and adaptation of the usual management of DRFs. More than half of all DRFs managed nonoperatively during the first peak had at least one radiological parameter that would have constituted an indication for operative management. We anticipate an increased load on the upper limb elective services as a result. This should be taken into consideration when planning exit strategies as well as funding and capacity building that is associated with it.

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- J. Baawa-Ameyaw: Developed the study hypothesis, Performed the literature search, Collected the data, Wrote the manuscript.
- R. Kabariti: Developed the study hypothesis, Created the data collection sheets, Collected the data, Wrote and edited the manuscript.
- A. Chandra: Collected the data, Performed statistical analysis, Edited the manuscript.
- J. Rhee: Developed the study hypothesis, Edited the manuscript.

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