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Paradigm Shift in Orthopedic Residency Training in Times of Covid-19 Pandemic: Experience of an Indian Teaching Institute

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Abstract

Background: The resident training program took a backseat during the covid-19 crisis. This paper describes new ways and strategies of orthopedic resident training and conducting exit exams during this pandemic. **Subjects and Methods:** A retrospective observational study was done in the department of orthopedics over a period of two months during the pandemic at a teaching level hospital in India where orthopedic and non-orthopedic work and academic activities attended by the residents were compared from the data from the preceding two months of the crisis. Various means of conducting the summative exams were also analyzed. A p- value< 0.05 was found to be statically significant. **Results:** Out of 34 residents, thirty-three residents were present in the department along with 12 fellows and three senior residents. Residents were divided into three teams to provide COVID and emergency services. All elective operations and routine out-patient department services were suspended during the pandemic. 27 major orthopedic operations and 38 academic activities were carried out. No significant correlation was found in the academic activities and attendance of the residents during the pandemic and preceding period. The exit exams were also conducted in a novel way with the help of a digital platform. **Conclusion:** The resident training was compensated by interactive sessions on digital platforms.

Keywords: Orthopaedics, Resident training, covid-19, Operation, Academic activities.

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Introduction

The recent pandemic of Covid-19 has presented unprecedented challenges affecting the social, economic and political aspects of humanity. The rising threat of the covid-19 epidemic forced the Indian prime minister to declare a nationwide lockdown from 25^{th} March 2020 to 31^{st} May 2020. The public health care system in India has an acute shortage of health care workers, hospital beds and ventilators. To tackle this, all nonessential health services were stopped.[1] Gatherings such as lectures, seminars and national and international level conferences were suspended to further prevent the spread of the virus among the health care workers. Moreover, fellowships and workshops were either canceled or postponed indefinitely.

With all the focus on Covid-19, Orthopedic resident training took a backseat. The resident training program in India is of three years with a tight training schedule with academic activities including case presentation, seminars, cadaveric workshops, lectures, ward rounds and performing surgeries under supervision. Cessation of elective operation theatres and out-patient department led to a decrease in patient load and number of operative procedures performed in the institute. This created panic, anxiety and frustration among the residents. This would have a ripple effect on the level of confidence and skills acquired due to loss of essential time from their training period.

But in these times of crisis, Orthopedic resident training cannot be suspended indefinitely. New ways and methods have to be devised to continue the same. This paper describes the various methods and strategies to compensate for lost days and opportunities for Orthopaedic resident training in times of covid-19 pandemic crisis.

Subjects and Methods

A retrospective study was conducted in the Department of Orthopedics of a tertiary care teaching hospital in north India. Data was collected from the resident teaching in charge, as well as central authorities in the hospital administration. We looked at a number of orthopedic residents present in the institute during the pandemic. Their duty hours with respect to non-orthopedic work in COVID areas as well as orthopedic work (emergency cases attended by the residents) were analyzed. Academic activities such as journal clubs, seminars and didactic lectures during the course of the pandemic with effect from March 25th, 2020 to May 31st, 2020 were also analyzed. This data was compared with the preceding two months when routine hospital activities were taking place. This was a time period when yearly orthopedic exit exams also took place. Various methods of conducting the same were analyzed. The results were calculated in the excel sheet and statical analysis was done, if any, on SPSS 23.0 software. A p-value < 0.05 was taken as statistically significant.

Results

During the course of the pandemic, out of the 34 junior residents in the department 33 were available for their duties. One of the junior residents was on leave and couldn't attend the institute in view of the suspension of air and train travel. During the same period, 12 orthopedic fellows were also working in the department along with three non-academic senior residents. A distribution of junior residents and fellows is given in [Table 1]. To counter the unprecedented burden from the pandemic, residents were split into three teams. One team was responsible for providing care to COVID patients and the other team was responsible for providing services to the out-patient department and telemedicine department and management of orthopedic emergency patients. One team was kept as a reserve due to potential loss of residents to quarantine or likely infection in the future.[1] During the study period, all the routine OPD work and elective surgeries were suspended. The trauma center, which exists in a separate building 200 meters away from the main hospital complex, was designated as the COVID center. Rest of the hospital building catered to non-COVID patients. All the emergency patients reported to the COVID center and were screened for any flu-like symptoms and RT- PCR COVID testing was done on a case to case basis. If a patient was suspected to have COVID-19 like symptoms irrespective of his injury or condition, he/she was admitted and put in the holding isolation area and managed there till the RT-PCR reports came to be negative. They have then shifted to the main building accordingly. All the emergency orthopedic patients were admitted in this manner and they were operated on when their RT-PCR reports were negative and they were free from flu-like symptoms. The number of cases admitted during the study period was 30. Out of this, 27 major orthopedic procedures were carried out in the emergency operating room. The distribution of patients as per their diagnosis, a procedure carried and the total duration of hospital stay are shown in [Table 2]. The average hours of duties carried by an orthopedic resident during the pandemic were six hours. In the COVID screening OPD, one junior and senior resident from orthopedics and other disciplines were involved in the screening of the stable COVID 19 suspect patients and health care workers from 9 to 5 pm. The average duty hours assigned to an orthopedic resident at the COVID screening OPD was four hours. Apart from this, one junior and senior resident from all the disciplines was always posted in COVID emergency for management and screening of patients having any urgent conditions. The average duty hours assigned to an orthopedic resident in a COVID emergency was six hours. Along with the emergency services, the follow-up OPD of all Departments was also running from 8 am to 5 pm in a designated space outside the main hospital OPD block. One senior resident and one junior resident from the Department of Orthopedics were present in the same area. Apart from this telemedicine services were provided outside the main hospital complex from 9 am to 1 pm. One senior resident was posted from all the departments and was responsible for providing remote medical services to the patients living in far-off places.

In the initial two weeks of the pandemic, academic seminars and journal clubs were carried out in the classroom with the mandatory physical distancing of one meter circumferentially. The residents were instructed to wear a surgical mask and to practice hand hygiene by 70 percent alcohol solution during the same. The total hours of activities during this period were ten hours. During the latter seven weeks of the study period, all the classes with the physical presence of participants were completely suspended and the activities were carried out on various online group meeting platforms at a convenient time to ensure maximum participation of the residents since many residents were posted in COVID duties. These online platforms allowed interactive sessions and questions from the participants. The lectures were also recorded so that the residents could watch them afterward. The details of these activities with a total duration of hours and attendance of the residents are provided in [Table 3]. On comparison of the mean duration of academic activities during the study period (251.66 + 15.74 minutes per week) with the preceding control period (238.8 + 8.6 minutes per week), it was found that there was no significant difference in the same with a p-value of 0.54. An analysis of the average attendance of the residents in these academic activities during the pandemic (18+ 3.12) with the preceding 2 months of the study period (18.15 + 3.9) shows the attendance of the residents to be statistically insignificant with a p-value to be 0.81.

Table 1: showing the distribution of residents in the department of orthopedics

	Unit 1	Unit 2	Unit 3
1st year JR2nd year JR3rd year JR	2 4 5	3 4 4	3 5 4
Total	11	11	12
SR (non-academic)	2	1	
Fellows	2 (arthroscopy fello)	4 (spine surgery)	6 4 (pediatric orthopedics) 2 (joint reconstruction and arthroplasty)
Total Residents	15	16	18

JR: Junior Resident; SR: Senior Resident

The resident exit exams were carried out in a novel way. Summative exams comprised of a written examination based on multiple-choice questions and a practical examination which was divided into three parts. The first part consisted of six Objective Structured Clinical Examination (OSCE) stations with allotted times of 10 minutes each [Figure 1]. The second part consisted of three short cases. Since there were no patients, the short cases were conducted with the help of simulated patients enacting to create an actual case scenario [Figure 2]. Markings were made on the bodies of the subjects with non-permanent marker pens after prior permission. The same was done with the long cases. Each candidate was allotted one long case each. The duration of three short cases and one long case were 45 mins each. During the whole examination process, two external examiners were observing the activities online over an appropriate communication platform and they asked questions to the candidate as and when necessary. They were provided with evaluation sheets and students were scored on skills performed and affective domain. The objective structured clinical examination based on long and short cases were so structured that the role of subjective assessment by the examiners and hence any discrimination could be excluded.

Discussion

With the imposition of nationwide lockdown due to the COVID-19 pandemic all routine health services such as OPD and elective surgical work were suspended from March 25th, 2020 to May 31st, 2020. During this period, the trauma center building was segregated as a COVID-19 center, away from the main hospital complex. All the orthopedic emergency cases were first screened at this center for COVID-19 followed by their transfer to non-COVID areas, once the patient was declared free by appropriate testing. During the lockdown period, a total of 30 emergency cases were admitted and managed. Out of this, 27 cases underwent the major operative procedure. This provided the residents an opportunity to observe and conduct surgeries under supervision, although limited in number. During the preceding two months of the pandemic, the total number of major emergency procedures conducted was 85. Though the residents were exposed to a limited number of emergency operative work, this provided them with an adequate opportunity to develop their skills in these testing times. The experience and exposure gained during this pandemic would be of immense benefit to all the residents when such a pandemic arises in the future. The residents will be leaders in their respective fields and will be better equipped and trained to handle the work in future such pandemics. We agree that during the pandemic period the elective surgical cases decreased to almost nil. To compensate for this, residents were trained on cadaver models, sawbones and simulation-based laboratories.

Before the pandemic, the exposure of the residents to telemedicine consultation was almost nonexistent. The insight and experience gained by the residents during telemedicine consultation have provided them with a unique opportunity to use this method of consultation more frequently and aptly in the future and master the art of providing medical services to remote places.

Technological advancement with the latest teaching techniques provided the opportunity to develop a teacher-led, knowledge-based and student-oriented learning approach. Web combined with online video platforms allows virtual classrooms to be conducted with social distancing and bringing residents together for an interactive session with the faculty. Technologies such as podcasts and videos, mobile devices with applications, video games, simulations (part-time trainers, integrated simulators, virtual reality), and wearable devices (google glass) are some of the other means to supplement their learning.

The resident academic training did not suffer to a great extent as various digital platforms were used to compensate for physical academic activities. To integrate all the levels of bloom's taxonomy various seminars and journal clubs were conducted.[2] Though seminars mainly focused on lower levels of taxonomy such as knowledge and comprehension,

Table 2: List of emergency procedures performed during the pandemic

S. No	Diagnosis	Procedure	Duration Of Stay
1.	Posterior Wall And Posterior Column Fracture Of Acetabulum	Open Reduction and Internal Fixation with Plating For Posterior Column And Posterior Wall	5
2.	Open Grade 3A Fracture Both Bone Leg	Closed Reduction and Internal Fixation With Intramedullary Nailing	3
3.	AO Type A3 Fracture D9 And D11 Vertebra With Spinal Shock	Long Posterior Instrumentation From D8 To L1 with Decompression at D11	4
4.	Basicervical Fracture Neck of Femur	Closed Reduction And Internal Fixation with Cannulated Cancellous Screw	2
5.	Basicervical Neck of Femur Fracture	Closed Reduction And Internal Fixation with Cannulated Cancellous Screw	2
6.	Bicolumnar Acetabular Fracture	Open Reduction and Internal Fixation with Plating and Cannulated Cancellous Screw for Posterior Column Fracture	5
7.	Closed Neck Of Femur Fracture with Shaft of Femur Fracture with Undisplaced 2^{nd} Metacarpal Fracture	Closed Reduction And Internal Fixation with Long Proximal Femur Nail	2
8.	D8& D12 vertebra Compression Fracture with D11 Burst Fracture with Bilateral Lamina and Left Pedicle fracture of D11 vertebra With bilateral Inferior Facet Fracture of D10	Left Transpedicular Decompression And Short Fusion of D10-D11 and Instrumentation from D10-D12	4
9.	L2 vertebrae Fracture. Flexion-Distraction Injury with Frankel Grade A Neurology	Posterior Decompression and Instrumentation	2
10.	Extradural Compressive Myelopathy C7-T1 of vertebrae With Tuli And Kumar Grade 4- Pott's Spine	Anterior Decompression and Instrumentation	2
11.	Fracture Distal Femur With External Fixator In Situ	External Fixator Removal and Open Reduction with Internal Fixation with Distal femoral locking plate	3
12.	Intertrochanteric Fracture femur	Closed Reduction and Internal Fixation with Proximal Femur Nail	3
13.	Intertrochanteric Fracture femur	Closed Reduction and Internal Fixation with Proximal Femur Nail	2
14.	Surgical site infection of Old Subtrochanteric femur fracture with Implant in Situ	Wound Debridement	5

journal clubs focused on developing critical thinking and evaluation of the residents. Faculty shared their experiences and discussed many clinical scenarios to incorporate the higher level of taxonomy such as application and analysis during these academic activities. Online platforms allowed interactive sessions and questioning from the participants with a recording of the lectures. A total of 38 such activities were conducted during this period which was almost equal to the preceding two months of the pandemic. Here also, the pandemic has provided a unique opportunity to explore digital modes of presentation and participation. The digital academic interactive session is the way forward in the future. The residents can even conduct seminars and group discussions with their counterparts sitting in any part of the globe. The residents and faculty also attended various national and international webinars. This allowed the dissemination of scientific knowledge by eminent speakers worldwide without the need for travel.

15.	Fracture Dislocation of D11 and D12 vertebra (AO Type C fracture) with ASIA A Neurology At D12	Posterior Decompression and Instrumentation	5
16.	Spine And Liver Metastasis with Unknown Primary	Vertebral Bone Biopsy Under C-Arm	2
17.	Fracture Dislocation Of D11 and D12 (AO Type B fracture) with ASIA A Neurology	Posterior Decompression and Instrumentation	5
18.	L2 vertebra Burst Fracture (AO type A3) With ASIA Neurology D with Superior and Inferior Pubic Rami Fracture of Left Hemipelvis	Posterior Decompression and Instrumentation	5
19.	Segmental Fracture of D10 And D11 vertebra (AO TYPE-C) with ASIA Paraplegia	Posterior Decompression and Instrumentation	7
20.	Wound Dehiscence with External Fixator in Situ in Open grade 2 Fracture Both Bone Leg	Wound Debridement with Sequestrectomy	7
21.	Follow-up case of Periprosthetic Infection in a Case of Total Knee Replacement	Arthrotomy, Wound Debridement and Implant Removal and antibiotic spacer insertion	7
22.	Intertrochanteric fracture Femur	Closed Reduction And Internal Fixation with Proximal Femur Nail	3
23.	Supracondylar Fracture Femur With External Fixator in Situ with Pin Tract Infection	Debridement and Implant Removal	1
24.	Open Grade 3b Fracture Both Bone Leg with Fracture 1^{st} Metatarsal and Heel-Pad Avulsion	Wound Debridement and External Fixator Application with K -Wire Fixation And Split thickness skin grafting	5
25.	Closed Shaft of Femur Fracture	Closed reduction and internal fixation with Tens Nailing	7
26.	Closed Fracture Shaft of Femur	Closed reduction and internal fixation with Tens Nailing	2
27.	Grade 3 Supracondylar Fracture Humerus with AIN Palsy	Open Reduction and internal fixation with K- Wire	2

Table 3: Academic activity during a pandemic

Academic Activity During Ffirst 2 Weeks of Pandemic			
S No.	**Topic**	**Duration (hours)**	**Attendance**
Seminars			
1	Management of a Case of Congenital talipes equinovarus	1	12
2	Amputations of Lower Limb -Indications and Techniques	1	13
3	Class On Biomechanics	2	15
4	Demonstration Of Clinical Findings In A Case Of Arthritic Hip	1	16
5	Class On X-ray Presentation Of Spine Cases	2	13
6	Examination Of Hand	1	15

The amount of free time provided by the pandemic also stimulated the minds of the residents and faculty to complete their clinical research. They were able to analyze the academic and operative data and hence, prepare a greater number of manuscripts for publication in research journals. The number of manuscripts submitted to journals during these two months almost doubled from the preceding months.

There was apprehension on ways of conducting resident exit exams as there were no clinical cases available for the same. The examination was conducted on the basis of Miller's pyramid model which has four, hierarchical components.[3] On the lowest level of the pyramid is 'knowledge', the next level

Journal Club			
1	Anterior Cortical Window Technique Instead of Extended Trochanteric Osteotomy in Revision Total Hip Arthroplasty: A Minimum 10-Year Follow-Up. Park CH, Yeom J, Park JW, Won SH, Lee YK Koo KH. Clin Orthop Surg. 2019 Dec;11(4):396-402. Doi: 10.4055/Cios.2019.11.4.396	45 Min	15
2	Metabolic and Hemodynamic Results and Early Complications in Simultaneous Bilateral Versus Unilateral Hip Arthroscopy. Aguilera-Bohórquez B, Pachón M, Sánchez M, Ramos-Cardozo O, Cantor E. Clin Orthop Surg. 2019 Dec;11(4):380-387. Doi: 10.4055/Cios.2019.11.4.380	45 Min	17
3	Surgical Treatment Of The Radial Head Is Critical To The Outcome Of Monteggia-Like Lesions.Klug A, Konrad F, Gramlich Y, Hoffmann R, Schmidt-Horlohé K1.Bone Joint J. 2019 Dec;101-B(12):1512-1519. Doi: 10.1302/0301-620X	45 min	14

Academic Activities on Online Platforms			
S NO.	**Topic**	**Duration (Hours)**	**Attendance**
Seminars			
1	Examination of Foot	1	16
2	Management of A Case of Congenital talipes equinovarus	1	20
3	Class on Deformity Correction of Lower Limb	1	12
4	X-ray Teaching Of Hip Cases	1	22
5	Statistics in Orthopaedics	1	18
6	Examination in Brachial Plexus Injury	1	19
7	Management of Ewings Sarcoma - Current Concept	1	18
8	Examination of a Case Of Hallux Valgus	1	19
9	Examination of Spine With Neurological Examination	1	16
10	Current Concept in the Management of Pott's Spine with Neurological Deficit	1	19
11	Biopsy Of Musculoskeletal Tumors	1	20
12	Complications Of Fractures And Dislocations	1	20
13	Orthopaedic Aspect of Child Abuse	1	21
14	Evaluation of A Child With Limp	1	23
15	Surgical Approaches For Total Hip Arthroplasty	1	24
16	Tunnel Placement In anterior cruciate ligament Reconstruction-Evidence-Based	1	22
17	Stem Designs In Total hip replacement	1	22
18	Basics Of Arthroscopy and Arthroscopic Anatomy of Knee	1	16
19	Constraint Knee Implants In Total knee replacement	1	19
20	Meniscal Repair and Meniscal Ramp Lesion	1	20
21	Acetabular Components In Total hip replacement	1	21
22	Graft Fixation Techniques in Anterior and posterior cruciate ligament Surgery	1	19
23	Bone Cuts in Total Knee Replacement	1	19
24	Management Of Bone Defects in Total knee replacement and Role Of Tibial Stem	1	20

Journal Club			
1	Total Elbow Arthroplasty: Clinical Outcomes, Complications, and Revision Surgery. Kwak JM, Koh KH, Jeon IH. Clin Orthop Surg. 2019 Dec;11(4):369-379. Doi: 10.4055/Cios.2019.11.4.369.	30 min	17
2	The Effect Of Patellar Thickness On Gait Biomechanics Following Total Knee Arthroplasty. Parke EA, Nakasone CK, Andrews SN, Wright AR, Stickley CD. Knee. 2019 Nov 25. Pii: S0968-0160(18)30826-3. Doi: 10.1016/J.Knee.2019.09.021	45 min	14
3	Morphological Risk Factors associated with Dislocation after Bipolar Hemiarthroplasty of the Hip in Patients with Femoral Neck Fractures-A Nested Case-Control Study. Zhang Y, Yao Z, Shi P, Wang C, Liu J, Yang Y, Zhang C. J Orthop Surg Res. 2019 Nov 28;14(1):395. Doi: 10.1186/S13018-019-1409-1	45 min	18
4	Operative Times in Primary Total Knee Arthroplasty: Can We Predict The Future Based on Contemporary Nationwide Data. Sultan AA, Samuel LT, Karnuta JM, Acuña AJ, Mahmood M, Kamath AF1.J Knee Surg. 2019 Nov 28. Doi: 10.1055/S-0039-3400949	45 min	21
5	The Lateral and Medial Approach in Total Arthroplasty for Valgus Knee: A Meta-Analysis Of Current Literature. Xu G, Fu X, Tian P, Bahat D, Huang Y, Li Z.J Comp Eff Res. 2019 Nov 28. Doi: 10.2217/Cer-2019-0111	45 min	19

stands for 'application of knowledge, the third tier represents 'clinical skills competency' and finally, on top of the pyramid is 'clinical performance. The lower level processes account for the cognitive components and were conducted by theory examinations via multiple-choice questions. To test the higher tiers of the pyramid which account for the behavioral components of clinical competence, practical examinations were conducted. Practical examinations included six stations of objective structured clinical examination and clinical cases (three short and one long case). Objective structured clinical examination allowed for objective assessment in a measurable way through the observation of residents across a series of timed stations, evaluated by standardized checklists. Cognitive assessments such as decision-making and reasoning ability were tested by the clinical cases. This way of conducting the examination based on Miller's pyramid model allowed for us to assess how the residents will behave during real-life situations. This pandemic also forced the faculty to explore other digital modes of conducting the examinations. The importance of simulation lab in the department was realized during this period. The innovative ways of practical examinations conducted during a pandemic will be of immense help in the future if the need arises.

Orthopedic residents during their typical curriculum have limited exposure and knowledge in managing non-orthopedic cases. The institute authorities realized that in times of such crisis all the residents irrespective of their surgical specialty may be assigned to care for sick patients. So various training programs like ECG rhythm analysis, ventilatory management and intensive care of the patients were conducted. This helped the residents to take care of sick patients in the ICU during the pandemic.

Conclusion

Although elective surgical training took a backseat during the pandemic but it was well compensated by interactive learning sessions on digital platforms and by acquiring new skills in the management of non-orthopedic care.

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