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Review article

Arthroscopy and COVID-19: Impact of the pandemic on our surgical practices

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ABSTRACT

The aim of this article is to study systematically current evidence on status of arthroscopic surgeries during the COVID-19 pandemic. We aim to study (1) changes in global arthroscopic practices, (2) recommendations on reducing risk to patients and health care workers (HCW), (3) changes in follow-up protocols of these patients.

Systematic search was carried out by two different reviewers using three different online databases for all studies published in the English language before April 2020. The total number of abstracts screened initially was 314. After screening of these abstracts, a total of 13 studies were included for the systematic review.

Numbers of orthopaedic injuries have seen a sharp fall during this time. Most elective surgical facilities were also closed at this time. Most studies have recommended telemedicine as an essential medium of providing continued care to patients during COVID-19. Studies have recommended that a conservative approach should be preferred for most patients with ligament injuries, and alternative procedures that have less requirement for an operating room should be explored. Common recommendation in all studies is that procedures of more elective nature should be postponed to a safer time frame when the transmission of COVID-19 virus in the population has declined. When surgeries are resumed, there is a need for triage of arthroscopy procedures from more important or urgent to less important ones. Elective surgical procedures should preferably be started with patients with no co-morbidities and lesser risk of peri-operative complications.

All patients undergoing surgery and health care personnels should have some screening for disease. Attempts should be made to have shortest hospital stay. Choice of anaesthetic procedure should emphasize on minimal aerosolization of the virus. Regional anaesthesia is the preferred choice as far as possible. Most guidelines have recommended that patient follow up should be made telephonically or on video-conferencing.

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1. Introduction

The novel coronavirus disease 2019 (COVID-19), caused by the severe acute respiratory syndrome coronavirus 2 (SARS Cov-2), started in Wuhan district of China in late 2019 and has made a huge dent on global economy. It has presented unexpected challenges to healthcare institutions worldwide. High infectivity and

low mortality of the infected patients make it a suitable agent for a pandemic. To contain spread of the virus most nations have implemented lockdowns, social distancing and quarantine. Healthcare resources have been diverted to cater the COVID-19 infected patients.¹ This has led to shut down of many elective surgeries and outpatient services. With time, most nations have realized that war with this infection is not easy. It is expected to continue for a long time and essential services need to carry on.

Guidelines have been issued for many surgical disciplines on resuming patient care. Several such guidelines have been issued for patients needing orthopaedic care. In orthopaedics mostly life or

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limb saving surgeries are being performed.² Management of other injuries that potentially impair function and quality of life remains a challenge. The arthroscopic surgeries are the standard of care for many ligament and soft tissue injuries. There is still an ambiguity regarding the indications and protocols of arthroscopic surgeries amidst the pandemic.

The aim of this article is to study systematically current evidence on status of arthroscopic surgeries during the COVID-19 pandemic. We aim to study (1) changes in global arthroscopic practices, (2) recommendations on reducing risk to patients and health care workers (HCW), (3) changes in follow-up protocols of these patients.

2. Material and methods

Systematic search was carried out in confirmation with Cochrane Collaboration, Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Literature search was carried out by two different reviewers using three different online databases: PubMed (<http://www.ncbi.nlm.nih.gov/pubmed>), EMBASE (<http://www.elsevier.com/online-tools/embase>), and Google Scholar, for all studies published in the English language before 31 May 2020. Search was carried out using terms: (“COVID-19” “coronavirus”) AND (“Arthroscopy”, “ligament injuries”, “Orthopaedics”, “ligament injury”, “Knee injuries”). References of all the included studies were also screened. ‘Similar articles’ and ‘cited by’ option on PubMed were also used. Websites of following orthopaedic or medical societies were also searched for available guidelines: British orthopaedic association, American association of orthopaedic surgeons, American college of surgery, Royal college of surgeons, ESSKA and SICOT.

Search was not limited by the type of study. All studies irrespective of level of evidence were included for this review. Literature on this topic is expected to be recent. Many guidelines on orthopaedic surgeries are expected to include recommendations on arthroscopic surgeries. Hence, we also screened studies on orthopaedic practices during COVID-19. Data was extracted from the included studies by 2 independent reviewers.

3. Results

The total number of abstracts screened initially was 314. After screening of these abstracts, a total of 13 studies (Table 1) were included for the systematic review. Fig. 1 shows the PRISMA flow-diagram for the literature search. There were eight review articles, four guidelines from experts and one editorial commentary.

3.1. Impact on elective clinics and surgeries

Numbers of orthopaedic injuries have seen a sharp fall during this time.^{1,2} Most studies in the review agreed that all major elective surgeries are shut during this period.^{3–11} Though the number of sports injuries have decreased, facilities to manage them early have also decreased tremendously. Massey et al.⁴ has suggested that extend to which elective operating is shut should depend upon the needs of the respective hospital. Rationalization of resource utilization to cater to COVID-19 pandemic should be kept in kind. They suggested that length of stay can also be considered along with urgency of the surgical procedure in deciding which procedures should be allowed to be performed.

3.2. Telemedicine tool

Most studies have recommended telemedicine as an essential medium of providing continued care to patients during COVID-

19.^{3–5,7–9,12} It has become difficult for patients to reach hospitals to seek care and for hospitals to provide a safe environment for the non-infected patients. Safety of HCWs is also at stake, which can prove more dangerous in terms of spread of the infection. Surgical consent prior to surgery is also recommended by authors to be made on a virtual platform to avoid or shorten hospital visit and exposure to a greater number of people.¹²

3.3. Back-trail to conservative treatment

Studies have recommended that a conservative approach should be preferred for most patients with ligament injuries, and alternative procedures that have less requirement for an operating room (OR) should be explored.^{5,8,13} This will reduce the risk of exposure to patients and HCW and will also reduce burden on hospital resources which are already working at a stretched capacity.

3.4. Delay is desirable

Before any procedure is contemplated, impact of delay on primary surgical outcomes should be considered. Whereas urgent procedures may not be delayed, for example arthroscopic lavage for septic arthritis, procedures of more elective nature should be postponed to a safer time frame when the transmission of COVID-19 virus in the population has declined and the peak of new cases has fallen. The exact fate of this virus is unknown, and this uncertainty may continue to linger for some more time.¹⁰ A balanced approach has to be adopted, for not risking health and life of the patients and HCW and at the same time not depriving patients of the timely required surgeries.

Most studies agree that there are only a few indications for acute treatment of knee ligament injuries.^{3,4,8,10,12–14} Most single ligament injuries like anterior cruciate ligament (ACL) or posterior cruciate ligament injuries are generally managed in a delayed fashion with good outcomes.¹⁰ Trend to operate early on these injuries is more recent. It has not shown any benefit in literature, and had to defend itself from reported complications of early surgery.¹⁵ Patients operated acutely and those operated after six weeks of injury have been shown to have similar outcomes.^{16–18} In patients with repeated instability episodes, incidence of cartilage changes and meniscal tears have been shown to increase 1 year after the injury.^{19,20} Meniscal injuries similarly are generally given a trial of conservative treatment, unless it presents with an acute locked knee.^{8,10,13,14,21}

Combined guideline from the British orthopaedic association and other orthopaedic societies of British origin⁹ has recommended that ligament injuries of the knee may be managed with bracing in preference to early ligament reconstruction. A removable brace should be preferred to a cast for extremity injuries. A specific follow up duration is not recommended for these patients, but a patient-initiated follow up is recommended.

Ding et al.¹³ defined surgical timings of various arthroscopic procedures based on a review of the literature. Acute tendon rupture was the only condition needing surgery in less than a week. Other indications that needed treatment within 3 weeks included anterior/posterior cruciate ligament avulsion injuries, multi-ligament knee injury, displaced osteochondral fractures, acute/severe rotator cuff tears and acute types III, IV, V, and VI acromioclavicular joint dislocations.

3.5. Triage of surgical procedures

Many authors have recommended that there is a need for triage of arthroscopy procedures from more important or urgent to less important.^{3–5,8,10–14,21} Al-Jabir et al.⁵ recommended that

Table 1
Summary of the Literature on Arthroscopy Practices in COVID-19 Pandemic

S.No	Study	Year	Region	Study design	Methodology	Results regarding arthroscopic surgery/ligament injuries
1	Sarac NJ et al. ¹¹	2020	North America	Review (in US states)	Internet search engine	Procedure performed during COVID 19 outbreak at The Ohio State University. Displaced meniscal tears associated with locked knee Select acute ligament disruptions Tendon lacerations and Ruptures Recommendation for pediatric orthopaedic patients Knee ligament injuries/Patellar managed by brace for 7–10 days, then commence ROM and directed written physiotherapy program. Teleconference at week 6 Dislocations and directed written physiotherapy MRI at month 3 to 4—late program reconstruction. ACL and shoulder reconstruction surgeries to be postponed. Locked knee/Bucket-Handle meniscal tear Admit for surgery-Arthroscopy ± repair Urgent surgical procedure-Use surgical Recommendations. Give written physiotherapy Instructions. Teleconference at week 6—with advice depending on surgery performed. Osteochondritis dissecans-Postpone Surgery.
2	Farrell et al. ⁸	2020	Australia, Canada	Review		Described time frame for the surgery. Knee: Acute tendon ruptures (patellar or quadriceps) surgery in <1 week, Dislodged osteochondral fractures surgery in <2 weeks, Multi-ligament knee injury surgery in 2–4 weeks, Anterior/posterior cruciate ligament avulsion injuries surgery in <3 weeks (<2 weeks for tendinous avulsion), Meniscus tears surgery in <12 weeks. Shoulder: Acute/severe rotator cuff tears surgery in <3 weeks Recommendations for resuming elective surgery
3	Ding B.T.K et al. ¹³	2020	Singapore	Review	Database search (PubMed, Embase, Scopus, web of science, google scholar)	Recommended non-operative management of ligamentous knee injury patients. Ligamentous injuries of the knee may be managed with bracing in preference to early ligament reconstruction.
4	Mouton C et al. ¹²	2020	ESSKA	Recommendations		
5	Al-Jabir A et al. ⁵	2020	United Kingdom	Review		
6	British Orthopaedic Association ⁹	2020	BOA, OTS, BSSH, BAPRAS, BSCOS, The British Association of Hand Therapists United Kingdom	Recommendations		
7	Gilat R. and Cole B.J ⁷	2020	North America	Editorial Commentary		
8	Massey P.A et al. ⁴	2020	North America	Review		Categorized major orthopaedic surgeries by how long they can safely be delayed. Classified ligament and tendon repair or reconstruction surgeries as Priority C (expedited within 2 weeks) and Priority D (Within 3 months) Recommendations to return to orthopaedics operating rooms, Multilevel approach to clinics A drastic reduction in arthroscopic procedures like rotator cuff repair and cruciate ligament reconstruction and an almost total shutdown of elective total joint arthroplasty was reported. Described ligament knee injuries as “Surgically Necessary” for Elective- Urgent Procedures Locked knee with entrapped meniscus as level 2 surgery (with 1–2 weeks) Multi ligamentous knee injury, Acute ACL with meniscal injury in young patient as level 4 surgery (delayed up to 3months) Knee Arthroscopic/open reconstructive procedures for meniscus/ligaments/tendons, Shoulder Arthroscopic/open reconstructive procedures for labrum/rotator cuffs, AC joint, capsule plication, Cartilage reconstruction procedures as level 5 surgery (delayed more than 3 months)
9	de Caro F et al. ¹⁰	2020	Italy, Switzerland, Belgium	Review		
10	Liebensteiner M.C et al. ³	2020	Austria, Germany, Switzerland	Review	Online survey	
11	DePhillipo N.N et al. ¹⁴	2020	North America	Recommendations		
12	Al-Rashed A et al. ²¹	2020	Kuwait	Recommendations		
13	Zagra L et al. ⁶	2020	Italy, Poland	Review	Data from the hospital	Reported decrease in number of patients planned for orthopaedic surgeries. Surgeries for Acute tendon lesion was authorized by Regional Authorities since March 14th 2020.

procedures can be triaged as those leading to threat to patient life if not performed immediately, those leading to permanent organ dysfunction if not performed and those with a risk of rapidly progressing severe symptoms and disease progression if not performed.

Guidelines of Kuwait association of surgeons divided orthopaedic procedures in levels of urgency.²¹ Septic joints (when managed arthroscopically) formed the only foremost indication for surgery. This was followed by locked knee with entrapped

meniscus. They were followed by multi-ligamentous knee injury and acute ACL with meniscal injury in young patient. All other reconstructive arthroscopic procedures were in the last recommended level of priority.

Sarac et al.¹¹ studied guidelines on elective surgeries by different states in USA. Most guidelines issued by the state were not clear on orthopaedic surgeries. They have recommended postponing of procedures which were not time-sensitive and did not endanger life, cause permanent dysfunction of extremity or risk progression

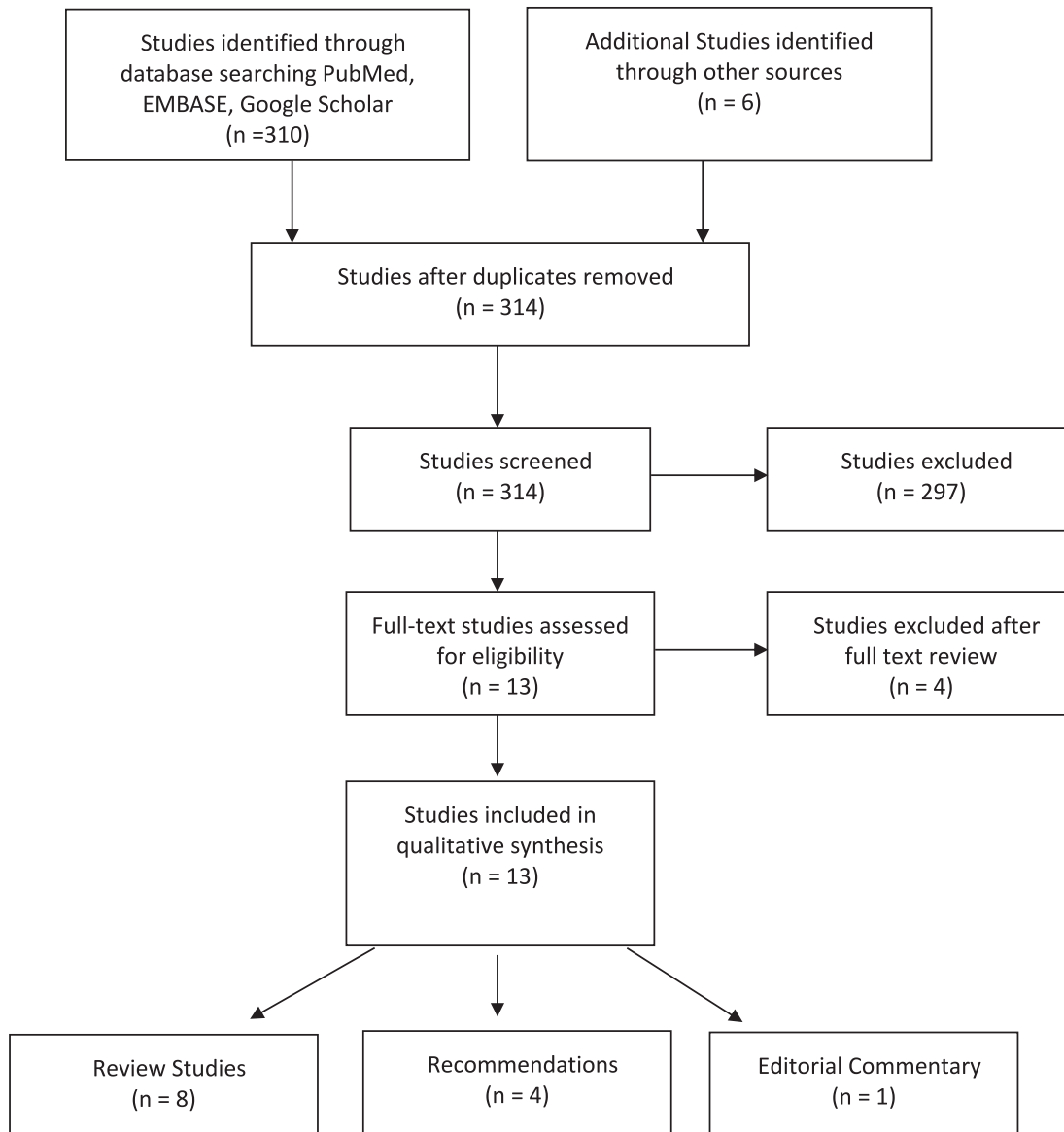


Fig. 1. PRISMA flow diagram

to severe symptoms. They also stated that procedures can be classified into categories according to priority. The procedures that they recommended to continue included displaced meniscal tears associated with locked knee, selected acute ligament injuries and tendon ruptures.

Similarly, DePhillipo et al.¹⁴ identified locked knees, bucket-handle tears of the menisci, acute knee injury, acute tendon ruptures (patellar or quadriceps), dislodged osteochondritis-dissecans lesions and anterior/posterior cruciate ligament osseous avulsion fractures as indications for urgent surgeries. These were identified as conditions that if untreated can lead to long-term disability and/or chronic pain.

Farrell et al.⁸ identified locked knee/bucket-handle meniscal tear as an indication for acute surgery. Other conditions such as paediatric ACL reconstructions, shoulder reconstructions and osteochondritis-dissecans were recommended to be followed up for surgery after the COVID-19 pandemic was over as the results of delayed treatment were as good as acute treatment.

Massey et al.⁴ also recommended triage of these patients for

arthroscopic surgery. They identified external fixation of knee dislocations as the only indication of emergency surgeries in patients with sports injuries. Ligament avulsion repair, locked knee from displaced meniscal tear, tendon ruptures, acute loose body removal and complete acromioclavicular joint dislocation as injuries to be operated in 2 weeks. ACL reconstruction, Multi-ligamentous knee reconstruction, Rotator cuff repair in young patients and Recurrent shoulder dislocation stabilization were recommended to be performed within 3 months.

Emergency department busy in management of patients with symptoms of COVID-19 infection cannot be a suitable place for evaluation and management of these patients. A separate clinic for emergency and out-patient management of these injuries in hospital should be created.¹⁰

3.6. When to resume surgery

Safety of patients, their attendants and healthcare professionals are the core consideration before routine surgical activities can be

resumed. Guidelines from ESSKA¹² have recommended that elective operating facility should be started in an area isolated from the general hospital catering to COVID-19 infected or un-screened patients. This could be a separate building or a separate institution catering to surgeries. Recommendations also include weekly testing of health care professional involved in delivery of care to the patients.

Surgical patients should be risk-stratified according to age, comorbidities and ASA grade.^{5,12} Elective surgical procedures should preferably be started with patients with no co-morbidities and lesser risk of peri-operative complications. Surgical Risk of COVID-19 exposure in these patients should be ascertained.

Liebensteiner et al.³ conducted online survey of orthopaedic surgeons in the German-speaking arthroscopy societies. There were 1399 responses. There were 10–30% responses that arthroscopies were still being performed. It varied with joints and indications. Response in favour of offering ACL reconstructions to patients were 25%. About 50% of the respondents said that rotator cuff repair was not being performed. Postoperative follow-up was severely affected. Routine clinical follow-up after surgery was available with only 57.1% of the participants and 11.9% of them were no longer following their operated patients.

3.7. COVID-testing before surgery

Up to 80% of people with COVID-19 showed mild or no symptoms at all.²² Routine preoperative screening for symptom is recommended.^{4,10,12,14} All patients undergoing surgery should have some screening for disease. ESSKA guidelines¹² have recommended that those patients who are not known to have been exposed or infected should get a COVID-RT-PCR (Reverse transcription polymerase chain reaction) test 48–72 h before surgery. For infected patients, surgery should be delayed for six weeks. Patients who are infected and have co-morbidities, these elective surgeries should be delayed for a longer time to reduce peri-operative morbidity. In patients who have signs and symptoms consistent with infection but have initially tested negative for COVID-19, or those who had been exposed to a COVID-19 positive patient but are asymptomatic, a repeat screen or a CT (Computed Tomography) scan should be considered before elective surgery. de Caro¹⁰ recommended that all patients be screened one day prior to surgery. They recommended CT scan as an effective and time-saving modality of screening. They also recommended that all HCWs be screened before facilities for elective surgery are opened.

Another important aspect regarding disease screening in arthroscopic surgeries is regarding use of allografts. It is being contemplated that COVID-19 testing of donors may be required in future and for recipients consent for risk of transmission of infectious diseases should include COVID-19 virus also.⁵

3.8. Peri-operative protection of patients and HCW

A risk-benefit assessment should be performed for each patient based on the urgency of the surgery. Surgeries with doubtful clinical efficacy need to be avoided. This is particularly important for procedures in elderly. Modifiable risk factors such as diabetes mellitus should be controlled prior to admission to reduce hospital stay.^{10,12} Risk of operating on an asymptomatic patient positive for SARS-CoV-2 is not clear.

For patients who have tested positive for COVID-19, arthroscopic surgery can be safely deferred. One possible indication for arthroscopy in such patients can be arthroscopic drainage of septic arthritis. Arthroscopic lavage can be preferred to open procedure in these patients. In such scenarios negative pressure rooms are recommended.²³ They should also be strongly considered for patients

who have a positive symptom screening where results of tests are not known.

Attempt should be made to minimize duration of hospital admission.^{4,8,10,12} Patients can be safely called on the day of surgery, once evaluation has been completed in the clinic. Target should be to deliver day care surgery as far as possible.^{4,10} A large number of arthroscopic patients are amenable to day care procedures. Multimodal pain management to avoid break-through pain and readmissions due to pain should be considered. Some hospitals may allow day care procedures to be carried on during this time as it places lesser stress on hospital resources and need for in-patient beds.⁴

Choice of anaesthetic procedure should emphasize on minimal aerosolization of the virus.¹⁰ Regional anaesthesia is the preferred choice as far as possible.^{4,10,12} It is preferable that patients also wear a surgical mask throughout the procedure.²⁴

3.9. Rehabilitation of patients under treatment

Sports injuries managed conservatively or operatively need a prolonged period of rehabilitation. Follow-up of patients after management of injuries or after surgical procedures is expected to be affected. In the survey by Liebensteiner et al.³ only 35.1% of the surgeons believed that their patients still had access to outpatient physical therapy. Most physical therapy facilities have shut down during this pandemic.

Most guidelines have recommended that patient follow up should be made telephonically or on video-conferencing as far as possible.^{8,12,25} Home-based virtual rehabilitation program after ACL reconstruction have been used in past and have shown to be well accepted by patients and result in good outcomes.²⁶

4. Discussion

Results of this review shows that facilities for arthroscopy have been severely affected by COVID-19 pandemic and resuming them will have to be gradual and phased. Tele-consultation should be encouraged. Patients should be risk-stratified. Elderly patients may be at a higher risk of morbidity and mortality from infections. Arthroscopic procedures should be avoided in these patients as far as possible in present scenario. Procedures such as rotator cuff disorders which was a frequent indication of arthroscopy in these patients can be managed non-operatively, and possibility of rehabilitation or local injections explored. It has made us to reflect upon and revise our surgical paradigm in many ways.

COVID-19 pandemic brought the world to a complete stand still in no time. COVID-19 had an unprecedented effect on medical care throughout the world. With the continuously increasing numbers of cases and mortality, there were lockdowns and “stay-at-home” restrictions globally. Impact of COVID-19 pandemic on sports injuries may be seen in two ways. On one hand all major sporting events in the world saw a halt. Recreational activities were also grounded. There are restrictions on gyms, parks and sports complexes. Thus, the number of injuries has decreased, but so have the facilities to treat them. There is a shift of manpower and resources from elective ORs to intensive care units to look after the virus infected patients.

There are several other notable findings regarding surgical practices. Concentration of virus in the bone and joint fluid may be less, but the fluid coming out from joint is potentially contaminated with blood. Adequate measures should be adopted during draping of patients to prevent spillage of this fluid in the OR. Adequate water-impermeable personal protective equipment including respiratory masks and eye protection shields are necessary to all staff working in the OR. A separate drainage cannula with suction

attached to it through a separate portal may be used during the procedure to reduce risk of contamination of the surgical apparatus and the floor of the OR. Floor suction devices should be in place to wipe off any spills of irrigation fluid. Trained surgeons and staff should participate in these surgeries to reduce surgical time. Surgeons should use technique most familiar with the assistants and staff and expected to give consistent results in shortest possible time. Arthroscopic surgeons frequently encounter that their gown, face-mask and shoe-cover are compromised from the splashed blood-mixed irrigation fluid. Exposure should be avoided by following adequate doffing practices.

There is a risk of transmission of virus from smoke arising from electrocautery.¹⁰ The Royal College of Surgeons has warned that surgical smoke and intra-operative aerosol generation during laparoscopic procedures may risk exposure to health care personnel to COVID-19 in the operative room.²⁷ The situation might be different for arthroscopic procedures as they are performed with fluid insufflation of the spaces and joints. Though electrocautery is sparingly used during arthroscopy, its use can be avoided in open parts of the procedure such as graft harvest or collateral ligament reconstruction by use of tourniquets. Adequate sterilization of arthroscopic equipment should be ensured.

Socio-economic impact on the patients with sports injuries also cannot be denied.²⁸ Two contradicting scenarios have been seen in our experience. On one hand global economy has faced the wrath of lockdown and many patients are finding it difficult to afford treatment. On the other hand, some people might see home-stay and lock-down as an opportunity for getting done surgical procedures such as ligament reconstructions which require a certain period of rest. At this time safety of patients and HCW should be the foremost consideration.

We are still limited in our knowledge of this new virus. Many statements are observations from experience on COVID—rather than evidence from high quality studies. Enormous heterogeneity between articles was seen and only limited literature was available on the topic. Thus, we agree with de Caro et al.¹⁰ that a summary of findings is presented and a systematic review in true sense may not be possible at present.

5. Summary

- Health care has seen shut down of many elective surgeries and outpatient services.
- Socio-economic impact on the patients with sports injuries.
- A conservative approach should be recommended for most patients with acute ligament injuries
- Stratification of Arthroscopic surgeries based on urgency of its need is recommended.
 - Immediate Arthroscopic procedures: arthroscopic lavage for septic arthritis, locked knee with entrapped meniscus
 - Urgent Arthroscopic procedures (Within 3 weeks): Acute tendon rupture, dislodged osteochondritis-dissecans lesions and anterior/posterior cruciate ligament osseous avulsion fractures, acute/severe rotator cuff tears in young adults and acute types III, IV, V, and VI acromioclavicular joint dislocations.
 - Delayed or conservative Management: Paediatric ACL reconstructions, shoulder reconstructions, osteochondritis-dissecans, ACL ligament injury
- Hospital Measures:
 - A separate clinic for emergency and out-patient management.
 - Routine preoperative screening for symptoms.
 - Patients not known to be exposed or infected: COVID-RT-PCR test 48–72 h before surgery.

- For COVID-19 infected patients: Surgery delayed for 6 weeks or longer if possible.
- Operating Room Measures:
 - Regional anaesthesia is the preferred choice.
 - Adequate draping of patients to prevent spillage of fluid.
 - Adequate water-impermeable personal protective equipment.
 - Separate drainage cannula with suction inside the joint.
 - Floor suction devices.
 - Procedure to be done by trained surgeons and staff using most familiar techniques.
- Tele-consultation is recommended telemedicine as an essential medium of providing continued care

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Contribution of the author

Dr Tarun Goyal: Literature search, writing and editing the manuscript. Dr Bushu Harna: Literature search, writing and editing the manuscript. Dr Ashish Taneja: Literature search editing the manuscript. Professor Lalit Maini: Conceptualisation, Literature search and editing the manuscript

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