IBRA International Bone Research Association

FLASH 2022

Editor's Message

Sadly, many events had to be postponed or temporarily canceled at the beginning of 2022 due to social distancing measures and ongoing Covid-19 restrictions. However, despite the difficult global situation, we are now back on track and once again able to hold our IBRA courses worldwide in all three segments (Head, Upper Limbs and Lower Limbs).

We have also successfully re-started our fellowship program thanks to the relaxation of international travel restrictions and are once more able to offer and implement our scientific contributions at national and international congresses. There has been much active demand for our entire offer, clearly demonstrating that surgeons need and want to stay up to date with developments in the field.

Medicine and thus surgery are fields subject to constant change as our knowledge increases rapidly. In today's globalized age of digital information processing, the half-life of current knowledge is about five years. We must therefore constantly seek to educate ourselves and share our experiences with like-minded people both nationally and internationally, preferably in person.

Our continuing education programs must always provide a reliable overview of current trends and evidence-based techniques presented by surgeons with the greatest expertise and, where necessary, provide us with a forum to discuss the topics covered. It is also important to us to continue to offer continuing education credits for our national and international courses.

IBRA members shape our organization in many ways. Whether it is with their involvement in IBRA courses worldwide, assisting with the Scholarships, or writing numerous papers. Their support has made the continued growth of the Association possible!

On behalf of IBRA and especially to the surgeons who publish their technical reports in the three segments Head, Upper Limbs and Lower Limbs to enrich our Flash 2022, we express our great gratitude.

The IBRA Administration Team

Table of Contents

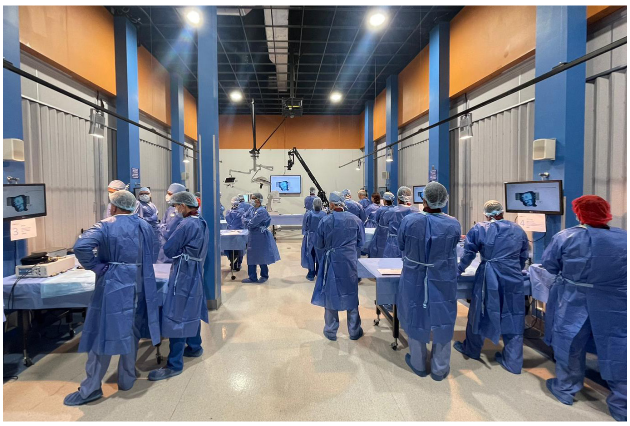
Short report on the IBRA Master Course Miami, June 3–4, 2022

Prof. Dr. med. Rainer H. Meffert
Head of the Department of Trauma, Hand, Plastic and Reconstructive Surgery
(Surgery II)
University Hospital of Würzburg
Germany

The first IBRA Master Course to take place after two years of Covid-19 lockdowns was entitled "Realistic Treatment of Hand, Wrist and Elbow fractures." Our host and chairperson, Dr. Alejandro Badia from the Hand to Shoulder Center in Miami, put together a fantastic 2-day program with a little support from me, which included both a theoretical and practical section.
In addition to Dr. Badia, our highly experienced faculty included Dr. Roy Cardoso from Miami, USA, Dr. Antonio Tufi from Belo Horizonte, Brazil, Dr. William Geissler from Jackson Mississippi, USA, Prof. Rames Mattar Jr. from São Paulo, Brazil, Dr. Carlos Rueda from Bogotá, Columbia, and myself.

Before starting bright and early on Friday morning, we spent Thursday evening enjoying a great get together at the "Jungle", Dr. Badia's beautiful waterfront villa. After a welcome drink we introduced ourselves and set off on Dr. Badia's boat to spend time together and discuss the program for the next two days. We saw the most wonderful sunset on the water with views of Miami and Miami Beach. On board we enjoyed a delicious dinner and at this point I would like to thank Dr. Badia again for his hospitality and for planning the perfect get together.

Quite early in the morning we took a bus transfer to the Miami Anatomical Research Center (MARC), a very comfortable space for presentations and hands-on workshops equipped with cutting-edge technology. The first day focused on the hand and wrist, and the theoretical section started off with a case discussion about spanning plates.
German experience in this area is very limited, but Dr. Cardoso shared his vast experience alongside some clear indications and technical notes. The discussion was quite lively and I got the feeling that we need to be open minded when it comes to an alternative to spanning plates.

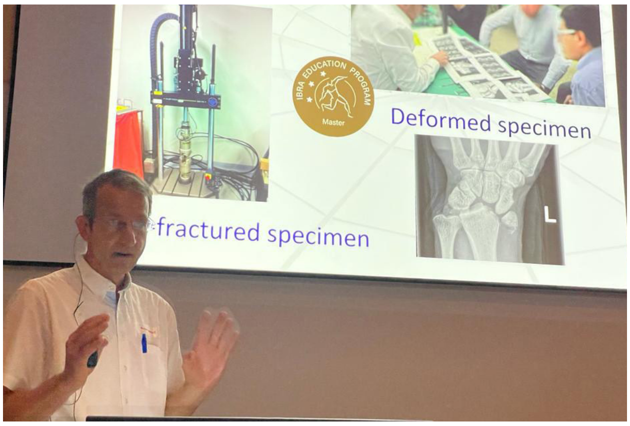


Unfortunately Prof. Rames Mattar could not attend the course in person, but he ran an interesting online session about fracture-specific plate selection. Dr. Carlos Rueda from Columbia then focused on associated lesions of distal radius fractures. Finally, Dr. Alejandro Badia contributed his vast experience on wrist injuries, presenting both pitfalls and solutions. We were delighted with the lively discussions we had with the audience, which was made up of twenty very experienced hand and trauma surgeons.

We then moved onto the wet lab practical section looking at fractures of the radius, carpus, metacarpus and phalanx. Coming up with a perfect solution to fix some of our prefractured specimens proved a real challenge. By drawing on the extensive experience of all the participants we were able to find appropriate solutions for complex fracture patterns. After a long day of work we returned to the hotel and all the participants and faculty members met in the lobby before enjoying a social dinner. A very unusual place was selected for our dinner. We ate in large high-ceilinged room with huge white walls that were used as screens for 360° image projection. Dr. Badia showed us many pictures including some that recounted the history of famous colleagues he had had the opportunity to work with.

What a great evening!

Next morning we started at 7:30 am. In Saturday's theoretical section about the elbow we looked at distal humerus fractures, radial head fractures, coronoid fractures, and Monteggia-like lesions. These high-level presentations were case driven and demanded extensive technical expertise.



After the presentations and discussions, we looked at different specimens with distal humerus fractures and proximal forearm fractures. These were again challenging complex fractures, all of which were analyzed using X-rays and CT scans. Finally, the results of the operation procedure were presented to the whole group. The feedback from the faculty and attending surgeons was very positive, and high-value learning and teaching was delivered with significant clinical impact.

In my experience as an IBRA member, we were able to benefit from IBRA's philosophy at its best. We had clear, case-based discussions based on extensive experience, and all in a friendly and open-minded atmosphere. According to my calculations, we enjoyed a total of 14 educational hours, and I would highly recommend adopting the same format in the future.

It was a great honor for me as a German trauma surgeon to share my experience in hand and elbow injuries and I certainly learned a lot from the other faculty members.

Prof. Dr. med. Rainer. Meffert

IBRA Strategy Meeting 2022

The IBRA Strategy Meeting 2022 took place in Liestal, Switzerland, from May 12–14.

It was a great pleasure to meet the representatives of the IBRA Board of Directors and the Research and Education Committees again in person:

- Prof. Dr. med Rainer H. Meffert, Würzburg, Germany
- Prim. Dr. med Wolfgang Hintringer, Vienna, Austria
- OA Dr. Christoph Pezzei, Vienna, Austria
- Prof. Dr. med. Dr. phil. Victor Valderrabano, Basel, Switzerland
- Prof. Dr. med. Hermann Krimmer, Ravensburg, Germany
- Dr. Radek Kebrle, Mladá Boleslav, Czech Republic
- Mr. Willi Miesch, Basel, Switzerland
- Mr. Peter Cologna, Basel, Switzerland
- Prof. Benoit Schaller, Bern, Switzerland
- Mr. Tim Lloyd, London, United Kingdom
- Prof. Rames Mattar Jr., São Paulo, Brazil
- Prof. Adam Watts, Wrightington, United Kingdom
- Mr. Claudio Darms, Basel, Switzerland
- Mr. Matthias Walter, Basel Switzerland
- Mr. Thiago Gonçalves, Basel, Switzerland

Two and half days of brainstorming, creative ideas, and groundbreaking decisions have paved the way for IBRA's future development. This includes:

- Simplification of the membership application process
- Standardization of the cooperation with and between IBRA Training Centers
- A new application process for scholarships
- Innovative ideas for education, research, and communication

A big thank you to all involved!

We look forward to taking IBRA to the next level and meeting again at the next Strategy Meeting in 2024!

Meet the IBRA Headquarters team

José Manuel Vázquez

- General management
- Organizational development
- Projects

Caroline Tschanz

- Training Centers
- Scholarships
- Virtual Campus
- Website

Karin Abt

- Finance
- Administration
- Memberships
- Research

Hwajeong Lee

- Global Promotion & Information
- Marketing Communication
- Social Media

Ariane Deussen

- Global Lead Chapter & Marketing Management

Katharina Roth

- Global Lead Scientific Education Extremities

An extensive global network of training centers provides an interesting range of options for scholarship applicants

Upper Limbs

Argentina
- Hospital Italiano, Buenos Aires
- Climba, Buenos Aires

Australia
- John Hunter Hospital, Newcastle
- Dandenong Hospital, Melbourne

Austria
- Unfallkrankenhaus Lorenz Böhler, Vienna
- Medical University of Innsbruck

Brazil
- Instituto Nacional de Traumatologia e Ortopedia, Rio de Janeiro
- Beneficência Portuguesa Hospital, São Paulo
- University of São Paulo, School of Medicine
- Hospital Israelita Albert Einstein, São Paulo
- Instituto Vita, Department of Hand, Wrist & Microsurgery Surgery & Department of Shoulder & Elbow Surgery, São Paulo
- Rede Mater Dei de Saúde Orthopedics, Trauma & Hand Surgery, Belo Horizonte

Chile
- Santa Maria Clinic, Santiago

Colombia
- Medellín Health Centers, Medellín

Czech Republic
- Klinika Dr. Pírka Mladá Boleslav

Germany
- St. Elisabeth Hospital Ravensburg
- University Hospital Cologne
- University of Würzburg
- Klinikum rechts der Isar, Munich

Italy
- Policlinico of Modena
- Policlinico GB Rossi, University Hospital Verona
- Galeazzi Hospital, Hand Surgery Unit, Milan
- Azienda Ospedaliero-Universitaria Careggi (AOUC), Department of Hand Surgery and Reconstructive Microsurgery, Firenze

Netherlands
- Maastricht University Medical Center

Singapore
- Singapore General Hospital (SGH), Hand & Reconstructive Microsurgery

South Korea
- Seoul National University Bundang Hospital
- Korea University Anam Hospital, Seoul

Spain
- Centro Medico Teknon, Barcelona

Switzerland
- Kantonsspital St. Gallen

United Kingdom
- Wrightington Hospital
- Guy's and St Thomas' NHS Foundation Trust, London

USA
- Badia Hand to Shoulder Center, Miami
- Banner University Medical Center at the University of Arizona-Phoenix

Head

Brazil
- São Paulo State University
- Hospital Samaritano, Higienópolis, São Paulo

France
- University of Amiens
- University of Lille

Germany
- University of Münster
- University Hospital of Giessen and Marburg

Italy
- Sapienza Università di Roma

Switzerland
- Inselspital University Hospital of Bern

United Kingdom
- Sheffield Teaching Hospitals

For detailed information, please visit our website.

Lower Limbs

Argentina
- Austral University Hospital, Orthopedic and Traumatology Department, Buenos Aires

Australia
- John Hunter Hospital, Newcastle
- Nepean Hospital, Orthopedic, Kingswood

Brazil
- Paulista School of Medicine - Federal University of São Paulo
- Hospital Israelita Albert Einstein, São Paulo
- Instituto Vita, Department of Foot & Ankle Surgery, São Paulo

Chile
- Santa Maria Clinic, Santiago

Germany
- Medical School at Diakovere Annastift, Hannover

Japan
- Laketown Orthopedic Hospital, Koshigaya

Spain
- Hospital Universitario de Canarias, Tenerife

Switzerland
- Swiss Ortho Center, Basel
- Kantonsspital Winterthur

United Kingdom
- Trauma and Orthopedic Department of the North West Anglia NHS Foundation Trust, Peterborough

USA
- University of Iowa, Carver College of Medicine, Department of Orthopedics and Rehabilitation, Foot and Ankle Division, Iowa City

IBRA Scholarships as of 2023

Goal of the IBRA Scholarship Program

The main goal of the IBRA Scholarship Program is to promote individual career development by providing financial support for clinical training and research. Scholars have the first-hand opportunity to exchange experiences with renowned clinicians at IBRA Training Centers.
IBRA Training Centers have been selectively chosen for their ability to provide broad clinical experience in patient treatment whilst promoting exemplary research.

Professional Requirements for Receiving Support

- Medical license (MD or a DMD diploma or the equivalent)
- At least two years' postgraduate training or clinical experience in orthopedic or trauma surgery
- Candidate must be fluent in English (Cambridge B2 or equivalent) or have sound knowledge of the local language of the desired IBRA Training Center
- No specific age limit (preference is given to younger colleagues)
- **For the B and C programs the applicant must fulfill at least one of the following criteria:**
    1. Be an IBRA full member or IBRA premium member (can be indicated in the application form)
    2. Have a recommendation letter from an IBRA full member or fellowship director of any IBRA Training Center (the applicant must be known to the IBRA member or fellowship director)
    3. Work in one of the IBRA Training Centers: A confirmation letter from the Training Center's fellowship director must be included with the application
    4. Have participated in an IBRA on-site course within the last five years (the course certificate must be submitted with the application)

Application Deadline

The deadline for all scholarship applications is January 31 each year.
Please note: Only application forms filled out electronically will be accepted. All required application documents must be submitted to the IBRA Administration Office by January 31.

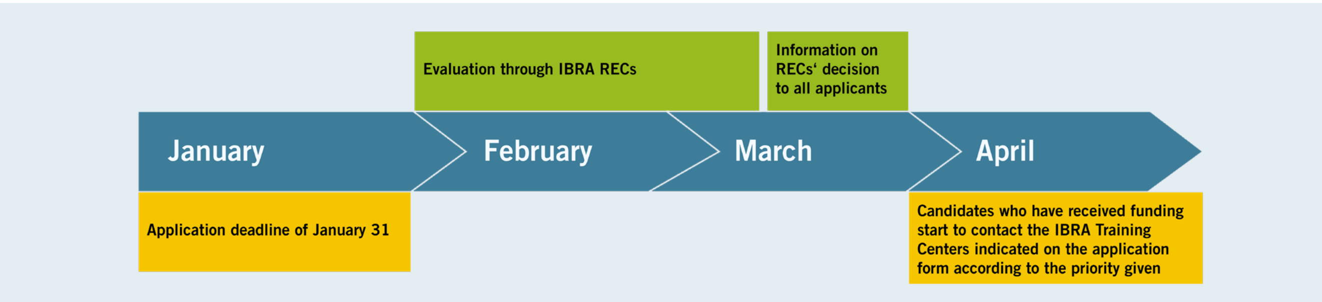
Scholarship Application Process

1. Candidates submit all required documents to the IBRA Administration Office by the application deadline of January 31.
2. The respective Research & Education Committee evaluates all the applications received by the application deadline of January 31.

   Candidates who do not meet the requirements will be rejected by the IBRA Administration Office. Incomplete applications will not be processed further.
3. The IBRA Administration Office informs all candidates about the Research & Education Committee's decision.
4. Candidates who have received funding must then contact the IBRA Training Centers indicated on the application form according to the priority given. The following documents must be sent with the request to the fellowship director of the Training Center:
    - CV
    - Funding confirmation letter from IBRA
    - Research project (program C only)
5. The confirmation of the IBRA Training Center must be sent to the IBRA Administration Office. The acknowledgment should state the agreed scholarship period and for program C the research project that will be worked on during the scholarship. The acknowledgment must be duly signed by the fellowship director.

The IBRA Administration Office will then pay the funds according to the IBRA scholarship terms and conditions that can be found on our website.

Please note:
For program C, the candidate will need to ensure that the research project submitted with the application can be completed at the chosen Training Center. In exceptional cases, the project can be changed in consultation with the IBRA Administration Office and the IBRA Research & Education Committee.



IBRA North America Chapter: 2022 Update

2022 has been a particularly exciting year for IBRA North America. Four advanced/fellow-level courses in the upper and lower extremities were scheduled in the US this year, compared to no course activity in 2020 and only two courses in 2021. After the Covid-19 shutdowns and restrictions, it has been wonderful to have both faculty and attendees return for scientific collaboration, networking, and hands-on learning with prefractured specimens.

First IBRA North America Ambassador

Dr. William Seitz, Jr. was nominated as the first IBRA North America Ambassador, and in his role will chair the newly developed North America Upper and Lower Extremity Research and Education Committees (REC). Dr. Seitz is the 69th President of the American Society for Surgery of the Hand (ASSH), Professor of Orthopedic Surgery at Cleveland Clinic/Case Western Reserve University, and the Chair of Orthopedic Surgery at Cleveland Clinic Lutheran Hospital. Dr. Seitz and the North America RECs will be pivotal in recommending educational curricula and reviewing educational scholarships, research grant requests, and North America Training Center applications. Under the guidance of the RECs, IBRA North America aims to develop the Chapter to serve the unique needs and requirements of the North American orthopedic surgeon community.

IBRA North America Research and Education Committees (REC)

IBRA North America Ambassador
Dr. William Seitz, Jr.

Upper Extremity Research and Education Committee
Dr. Mark Baratz
Dr. Duretti Fufa
Dr. Warren Hammert
Dr. Sanjeev Kakar

Lower Extremity Research and Education Committee
Dr. John Anderson
Dr. Eric Ferkel
Dr. Jordan Grossman
Dr. Cesar de Cesar Netto

Looking Ahead to 2023

In 2023, IBRA North America will continue to offer accredited courses, but will also look to increase educational opportunities for younger orthopedic residents interested in pursuing upper or lower extremity specialties. The Chapter's goal is to provide a continuum of IBRA education from Resident to Master levels with several annual course choices both regionally and nationally. Additionally in 2023, the Chapter will focus on developing the current US IBRA Training Centers, adding new Training Centers, and building awareness of the organization in all disciplines of orthopedic surgery of the extremities.

IBRA North America Chapter Director

IBRA has a long history in the Unite States. The first IBRA Course was held in Miami in 2009, and the North America Chapter was officially established as a non-profit society in 2019. In 2022, in addition to the formation of the North America RECs and the nomination of Dr. William Seitz as the North America Ambassador, Pia Levy joined in July as the North America Chapter Director. In her role Pia will lead all US-based IBRA Administration Office activities, including all US educational programs. She will implement the Board's strategic plans in the US, working closely with the IBRA North America Ambassador and the RECs.

Contact:
Email Pia.Levy@ibra.net
Phone +1 610 357 7024

IBRA Scholarship at the Badia Hand to Shoulder Center, Doral, FL 33166, United States

Fellowship director: Alejandro Badia, M.D, F.A.C.S

Scholarship program B in April 2022

Dr. David Bodansky
Senior Upper Extremity Trauma and Reconstruction Fellow
Sunnybrook Medical Center
Toronto
Canada

Information about the Scholar and Fellowship
I am David Bodansky, an Orthopedic Fellow from the United Kingdom. I completed my registrar training scheme (residency) in Liverpool in the UK and applied to IBRA to visit Dr. Badia at the Badia Hand to Shoulder center in Miami, USA under a program B scholarship in April 2022. Currently, I am a Senior Fellow in Upper Extremity Trauma and Reconstruction at Sunnybrook Medical Center, Toronto, Canada and after visiting other centers in North America, intend to return to London, UK to start my consultant training.

What were your professional and personal expectations of the scholarship?

My professional expectations of this scholarship were to see cases and conditions to which I had not had much exposure, in particular arthroplasty and arthroscopy of the hand and wrist. Further, I was looking forward to seeing how a private surgeon arranged his practice as my training to date has been in the UK's NHS, which is a hospital-based government funded social medicine system.
My personal expectations were to have the opportunity to discuss technical points with a mentor who could offer me the benefits of their experience and the opportunity to build connections for future collaboration. In addition, I was curious to talk through the differences and similarities of training and practice in the UK and USA.

What is the main focus of the IBRA Training Center (in general and of the department)?

The focus of Dr. Badia's practice is orthopedic hand and wrist surgery as well as upper extremity surgery. Dr. Badia has a particular interest in small joint arthroscopy and arthroplasty of the upper extremities.

What did you do during your scholarship/how were you incorporated in the training center's daily routines/activities:

I observed a busy clinic where Dr. Badia runs four clinic rooms, with ultrasound, XR, fluoroscopy, and an open MRI scanner all within one clinic set-up. In addition, I saw how the patient pathways flow from an adjacent acute care center, OrthoNow, and how the patient pathway can move from a preoperative assessment on a Monday to surgery on a Tuesday, review on a Wednesday, and then therapy at an adjacent therapy center. There is room for 12 patients with dedicated hand therapists.
I observed interactions with local and international patients from across the Caribbean as well as Central and South America. I also saw how Dr. Badia utilizes telemedicine, in particular for his international patients, to maintain follow-up and counsel them for surgery.

How many surgeries have you assisted at and which concrete technical modifications and methods have you seen?

I had the opportunity to observe 17 procedures in the operating room and was grateful to see a system that used three operating rooms to maximize efficiency. This was the first time I'd seen multiple operating rooms as in the UK, a surgeon only has access to one. This allowed me to understand methods to improve operating room efficiency, such as overlapping cases. I saw shoulder arthroscopy from the lateral position, which allows the glenohumeral joint to be distracted with a boom and allows superb visualization of the joint. I saw an endoscopic carpal tunnel release for the first time. Here, you make a transverse incision over the proximal wrist crease, from the ulnar to where the palmaris longus would be (however do not look for it as a landmark, as the PL is absent in 20% of the population). Key tips include ensuring you have a Ragnell retractor in the distal aspect of the skin incision to avoid cutting the skin when you are exiting with the endoscopic blade and that you release the distal forearm fascia from the proximal aspect of the skin incision. Full transverse ligament release is confirmed by observing the light in the palm. When injecting saline, the palm expands slightly. I saw a shoulder resurfacing implant, the Catalyst, which offers minimal bone resection on the humeral head allowing for later surgical procedures.

Fig. 1. A finger cast – cylindrical plaster of Paris covered in Coban wrap – applied directly onto the skin and worn for six weeks after a well-tolerate DIPJ fusion providing protection to the fusion site.

Specify three to five of your favorite procedures and/or new skills you acquired.

(NB: pictures were included with patients' written permission)

After a DIPJ fusion, Dr. Badia uses a finger cast to protect the fusion site for six weeks until the buried K wires are removed. This is a low-cost option that can be applied in clinic (the office), in comparison to a custom-made thermo-plastic splint, which I have seen previously and requires another visit for removal. Dr. Badia reported that patients tolerate this well and do not ask for it to be removed. Lateral epicondylitis (tennis elbow) is a clinical condition that can be challenging to treat. I had the opportunity to see a percutaneous ultrasonic tenotomy of the extensor tendon origin with a Tenex device that uses focused ultrasound to percutaneously debride the extensor tendon origin. This is inserted through a 1 cm skin incision distal to the elbow and targeted on the extensor origin under ultrasound control. This can be done as a day-case (ambulatory) procedure under sedation and is the first percutaneous option I've seen for lateral epicondylitis. Previously, I have seen open debridement which requires a general anesthetic and a longer recovery period. Intraarticular distal radius fractures require accurate reduction to reduce the risk of posttraumatic arthritis. Here, I saw wrist arthroscopy to assess the amount of articular step-off at the fracture site and achieve accurate reduction before fixation.

Fig. 2. Placement of the Tenex probe on the extensor origin to debride tendinosis.

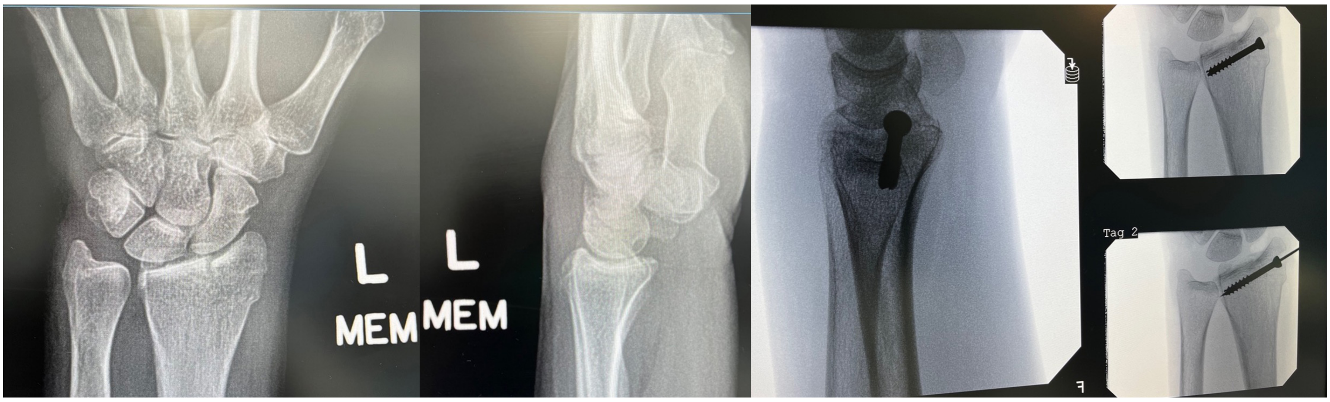


Fig. 3. Preoperative radiographs showing an intraarticular distal radius fracture. Intraoperative radiographs showing arthroscopic-assisted reduction and screw fixation.

The key tips are:

- *Insufflate with saline. Aspirate to confirm that you are in the joint and remove hematoma.*
- *Make a transverse incision as the scope moves left and right and the incision heals better than a longitudinal incision as it follows Langer's lines.*
- *Use a 2.0 mm scope and 3.0 mm shaver.*
- *Have saline to the scope on gravity.*
- *Identify the 6R portal site with a needle.*
- *Use a hook and Frier to lift the fracture fragment.*
- *Inserting a K wire to joystick the fracture fragment can be helpful before inserting a 4 mm cannulated partially threaded screw to achieve compression and hold reduction.*
- *Consider a first extensor compartment release. Look for EPB as a common site of compression.*

Which procedures could you potentially adopt in your future practice and how do they compare to your experiences at home?

Many of the techniques that I have seen could possibly be incorporated into my future practice in the UK. The finger cast works well and offers a cost-effective option; arthroscopic assessment of distal radial fractures can help us understand fracture configuration and aid reduction. I hope to bring some of the lessons I learnt from Dr. Badia's clinic set-up for managing patient flow back to the UK.

What was the most significant personal experience of the scholarship for you (e.g., cultural exchange)?

The most significant personal experience was the opportunity to hear from Dr. Badia about how the medical system works in the USA. He gave me a copy of his book (Healthcare from the Trenches, www.drbadiabook.com), which contains his insights into the challenges and benefits of working in that system.

Do you have any tips for future scholars (related to housing, traveling, etc.)?

It is helpful to arrange a hotel within walking distance. Give your number to the practice manager or surgical coordinator as well as the doctor you are visiting in case there is a change of schedule or any unexpected cases go to the operating room. Arrive well in advance and try to plan in some time to see any local sites.

Acknowledgments

I would like to thank IBRA for supporting my fantastic visit to Dr. Badia and his team. I have learnt a huge amount and above are only a few of the highlights of the many notes that I kept scribbling down during my time with Dr. Badia. I have appreciated the different ways of working and made a friend and mentor for the future.

Badia Hand to Shoulder Center

Miami, FL, USA
OrthoNOW orthopedic urgent care
Fellowship director: Alejandro Badia

The Badia Hand to Shoulder Center runs an active observership-type visiting fellowship where the surgeon typically spends several weeks to three months interacting with Dr. Alejandro Badia, a hand and upper limb surgeon.

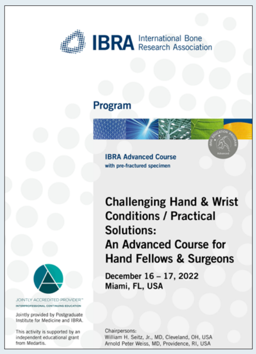
Acute upper limb injuries, such as fractures and soft tissue injuries, often present via OrthoNOW, the only orthopedic urgent care facility in South Florida and the pilot site for an international orthopedic urgent care franchise. This also presents the opportunity to see other community-type orthopedic injuries such as foot/ankle, knee, and spine injuries. The OrthoNOW facility is directly upstairs from the Surgery Center at Doral, a fully equipped ambulatory surgery center where major reconstructions are performed including arthroplasties and non-unions of the humerus. Many of the patients come from abroad, particularly Latin America and the Caribbean, providing an opportunity to see late reconstructions for trauma that were initially managed in less than optimal fashion in their home country. The nearby MIA airport and hotels facilitate the international patient experience, which is managed by an international patient coordinator who also organizes the visiting fellowship.

Dr. Badia is also cofounder of the nearby world famous MARC center (Miami Anatomic Research Center) where fellows may have the opportunity to perform some surgical cadaveric dissections and participate in organized courses during their fellowship.
The center is located in eastern part of the city of Doral, which is located two kilometers away from Miami international airport and is a small city noted for its business community and recent influx of affluent South Americans residing there. It also sits in the industrial hub of South Florida, with nearby manufacturing, aviation, and shipping companies that generate significant industrial injuries served by the center and surrounding occupational health centers.

IBRA ADVANCED COURSE WITH PRE-FRACTURED SPECIMENS

Challenging Hand & Wrist Conditions/Practical Solutions: An Advanced Course for Hand Fellows & Surgeons

Recommended for hand fellows and attending surgeons.
This course offers ideal conditions for the introduction and consolidation of surgical techniques. Participants will learn about current treatment concepts and new internal fixation techniques. Experienced surgeons will provide two theoretical sessions and scientific discussions on the first day. It also includes cutting-edge presentations about managing fractures, dislocations, instability, and reconstruction of challenging problems in the hand and wrist.
Day two of the workshop will give attendees the opportunity to apply the skills they have gained to fresh specimens under directed instruction. In the second part of day two, groups of four participants will learn unique hands-on anatomy sessions with real-life pre-fractured specimens and be able to manage these complex conditions.



December 16–17, 2022
Miami, FL, USA

More information can be found at: https://www.ibra.net/Events

Clinical Changes in Patients with Plantar Fasciitis Treated with Extracorporeal Shockwave Therapy

Marianyi P. Martinez, Marcio Freitas, Luis Marchi, Mauro Dinato

ABSTRACT

Extracorporeal shockwave therapy (ESWT) is a conservative care option for patients experiencing plantar fasciitis. The aim of this study was to study the clinical and radiological baseline parameters of a case series and describe the clinical outcomes after the ESWT. Thirty-two (32) patients were included (56% female, mean age 50.7, mean duration of the symptoms 16.4 months). The outcomes were analyzed with a mean follow-up time of 4.8 months. The MRI images evidenced signs of soft tissue edema in 56% of the patients, signs of bone edema in 78%, intrasubstance lesions in 53%, and fascia thicker than usual with a mean dimension of 4.6 mm. After the treatment, fewer patients reported walking limitation (19% vs 97%, p<0.001), running limitation (47% vs 100%, p<0.001), and pain after waking (22% vs 100%, p<0.001). No patients complained about ESWT-related adverse events, and in the time until the final FUP there was no need for surgical treatment. In this study we observed good clinical outcomes after ESWT for patients with plantar fasciitis.

Keywords: foot; plantar fasciitis; extracorporeal shockwave therapy

INTRODUCTION

Plantar fasciitis is a common chronic musculoskeletal disorder characterized by pain in the plantar fascia region; the area most commonly affected by pain is the origin of the fascia in the medial-plantar region of the heel near the medial tubercle of the calcaneus.[1,2]

Approximately 10% of the population has suffered or will suffer from foot pain throughout their lives, specifically pain in the plantar fascia, which we call plantar fasciitis. According to the World Health Organization (WHO), plantar fasciitis is one of the most frequent reasons for consultations in rehabilitation and trauma services. It is a problem that, day by day, affects a significant percentage of the world's population.[1,9]

Plantar fasciitis (PF) is the most common cause of heel pain and accounts for up to 15% of 33 foot symptoms requiring medical attention. It is associated with significant morbidity, resulting in mobility limitations for patients affected. PF is believed to be caused by biomechanical overloading of the plantar fascia insertion at the calcaneal tuberosity. Mechanical overload, whether because of biomechanical deviations, obesity, or prolonged standing work habits, may contribute to symptoms.[1,5,7]

There is a strong tendency towards spontaneous resolution, but in a proportion of patients a chronic syndrome may develop, and further treatment may be required. A variety of conservative treatments have been proposed for this condition, including stretching exercises, heel lifts, non-steroidal anti-inflammatory drugs (NSAIDs), and steroid injections into the painful area. A small percentage of patients go on to have an open release of the plantar fascia, but the results are not always predictable or satisfactory.[1,4,5,6,7]

Surgical treatments such as plantar fasciotomy have been recommended when non-surgical treatments fail. Recently, the development of extracorporeal shockwave therapy (ESWT) for the plantar surface of the heel has added a new dimension to the treatment of plantar fasciitis. However, the success rate of ESWT, which is based on subjective symptomatic relief of heel pain, remains variable.[8]

Magnetic resonance imaging (MRI) is used to diagnose plantar fasciitis. Objective evaluation can be performed using magnetic resonance imaging (MRI) findings, which include increased thickness of the plantar fascia, bone marrow edema, and formation of a calcaneal spur (osteophyte).[7]

The hypothesis was that patients with plantar fasciitis would experience a positive change in clinical outcomes after treatment with the shockwave method.

METHODS

This was an observational, retrospective, prospective, case-series, single-center study with study of the data from medical charts.
Inclusion criteria: Adult individuals diagnosed with more than six (6) months of plantar fasciitis, individuals with previous MRI study, failed treatment with NSAIDs, steroids, and insoles, and prescribed and performed treatment with ESWT. Exclusion criteria: Chronic systemic disease, such as neuropathies, rheumatologic diseases, tumors, and local infection, patients who did not comply with the indicated sessions.
After being included in the study, participants' medical records were studied so that the data relevant for this study could be extracted. The researchers contacted the patient by telephone to complete the data needed for the study.
The baseline data collected were sex, age, duration of the symptoms (months), walking limitation (yes/no), running limitation (yes/no), and pain after waking (yes/no). Pretreatment MRI images were analyzed, and the following parameters were extracted: sings of soft tissue edema (yes/no), signs of bone edema (yes/no), thickness of the fascia (in millimeters, measured as shown in Fig. 1), fascia rupture (yes/no), signs of intrasubstance lesion (yes/no), osteophytes (yes/no). The clinical outcomes collected before the treatment and at the final follow-up were walking limitation (yes/no), running limitation (yes/no), and pain after waking (yes/no). ESWT-related adverse events were collected.
A descriptive analysis of the data collected was performed. Pre- and post-ESWT qualitative parameters were compared using Fisher's test. The significance level adopted was p<0.05 (SPSS®).

Table 1. Demographic and baseline data

Patients (n)	32
Female	56%
Age	50.7 ± 9.5
Duration of the symptoms (months)	16.4 ± 22.9

Data are shown as mean ± standard deviation

Table 2. Baseline radiological data

Signs of soft tissue edema	56%
Signs of bone edema	78%
Fascia tickness (mm)	4.6 ± 0.8
Signs of fascia rupture	12%
Instrasubstance lesion	53%
Osteophytes	47%

Data are shown the percentage of the patients that presents such criterium and as mean ± standard deviation

RESULTS

Thirty-two (32) patients were included and analyzed in this study. The mean follow-up time was 4.8 months (2.5 standard deviation). Table 1 shows the demographic and baseline data of the study group.
Table 2 shows the radiological description of the patients from this study. As a sign of the inflammatory process, the fascia was swollen as the thickness values demonstrates. Bone edema was very prevalent, and an example can be found in Fig. 2. A few cases had a fascia rupture (Fig. 3), but most patients had inflammatory signs with intrasubstance lesions (Fig. 4) and almost half presented osteophytes (Fig. 5).

Table 3. Clinical baseline data and outcomes

	Pre	Post	*P* value
Limitation to walk	97%	19%	<0.001
Limitation to run	100%	47%	<0.001
Pain after waking up	100%	22%	<0.001

Data are shown the percentage of the patients that presents such criterium

Before the treatment, all patients had running limitation and pain after waking (Table 3). At the final follow-up visit, 22% of patients reported pain in the morning. Moreover, more than half of the group could run without pain again and the walking limitation decreased from 97% to 19% of patients (all differences with statistical significance).

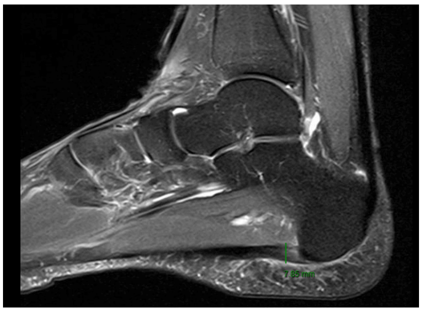


Fig. 1. A 64-year-old male patient with thickening and signal elevation in the proximal portion of the fascia (green line), predominantly in the central band.

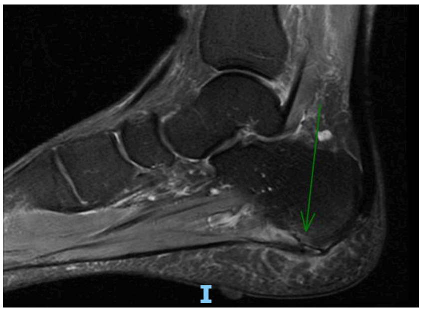


Fig. 2. Sagittal T2-weighted images with fat saturation of the hindfoot, soft tissue, and perifascial edema associated with subcortical calcaneal bone edema (arrow).

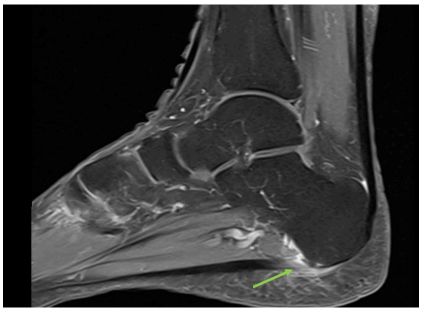


Fig. 3. Plantar fasciitis with intrinsic clefts, associated with inflammatory changes in adjacent soft tissues (arrow).

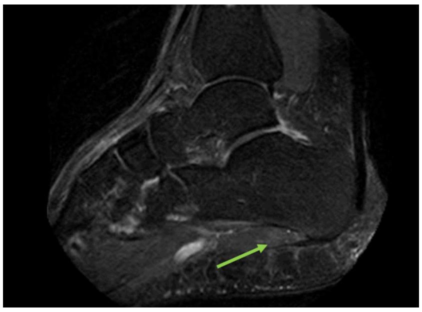


Fig. 4. Perifascial edema and intrasubstance tears in the proximal segment of the central band, without transfixion (arrow).

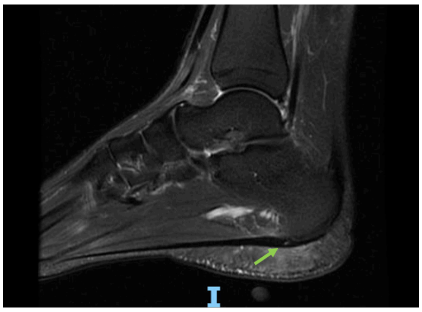


Fig. 5. Plantar fasciitis associated with a small calcaneal enthesophyte (arrow).

DISCUSSION

This observational study evaluated the efficacy of shockwaves in the treatment of chronic plantar fasciitis. It was observed that treatment with shockwaves achieved significant decreases in negative clinical outcomes (walking limitation, running limitation, and pain after waking) without obtaining any reported adverse effects related to the procedure, nor need for surgery. MRI findings usually show increased signal intensity on T2-weighted images in the fascia region reflecting a thickening that occurs most commonly in the heel, intermediate intrasubstance signal on T1-weighted images and increased signal intensity on fluid-sensitive images, edema in adjacent tissues around the fascia and bone marrow edema in the heel.[10] Similarly Zhu et al. reported that an imaging assessment of somatic changes after treatment would allow us to better understand ESWT and could prove valuable in the evaluation and selection of patients and the treatment planning process, and that objective measures such as MRI imaging would clarify some of the controversies regarding the efficacy and mechanism of action of ESWT.[8]

Shockwave therapy was approved for the treatment of plantar fasciitis in 2000 by the US Food And Drug Administration. It is considered an easy, effective, and safe therapy, and additionally can be an alternative to surgical treatment with a low complication rate and treatment cost.

Another study discusses the effectiveness of shockwaves in other pathologies such as Peyronie's disease, complex regional pain syndrome (previously known as reflex sympathetic dystrophy or RSD), knee osteoarthritis, spinal fusion, malignant cells, and gene therapy. In addition, the application of ESWT has been extended to non-musculoskeletal diseases.[11]

In a study of 30 patients run by Bicer et al., after treatment with shock waves, 70% were able to stand for more than 5 hours, mobility in the morning and pain levels improved significantly, and there was a significant improvement in pain after walking.[12]

Similarly, another retrospective study of 225 patients with plantar fasciitis observed an improvement in the American

Orthopedic Foot and Ankle Score (AOFAS) with a success rate of 70.7% at 3 months and 77.2% at 12 months of shockwave treatment. Previous steroid use, body mass index, and duration of symptoms did not seem to affect the results.[13]

When comparing five sessions of shockwave treatment with steroid use in a single intrafascial injection in a randomized design study, with both treatments there was a significant improvement in symptoms assessed using the Visual Analog Scale (VAS) and Foot Function Index (FFI) and in patient satisfaction assessed using the 4-point Likert scale. There was no significant difference in the main treatment effect between the two treatment arms, but more than half of the patients (55–60%) in the shockwave treatment group achieved therapeutic success according to the VAS and FFI at 8 weeks compared to steroid treatment (35–40%) at the end of the study.[14]

Elsewhere, a prospective study of 44 patients with diagnosed plantar fasciitis randomized to standard treatment (insole and exercise program) versus standard treatment alongside shockwave therapy concluded that both treatment arms improved the patients' functional performance after three months of treatment, a finding that was reached mainly due to the lack of a significant difference in the AOFAS-F scores and walking speeds.[15]

As there was no significant difference in the benefit observed with shockwave treatment versus placebo in a double-blind randomized trial at 6 and 12 months of treatment, the authors of this study concluded that there is no evidence to support the beneficial effects of shockwave treatment on pain, function, and quality of life.[16]

The limitations were the following: it was a retrospective study, not comparative, the number of patients was low, and no long-term radiological follow-up was performed after treatment with shockwave therapy.

These results confirm the clinical efficacy of ESWT for chronic plantar fasciitis. Shockwave therapy is an effective and simple treatment for those with chronic plantar fasciitis that do not respond to conventional treatment, because it has been shown to produce positive results in terms of pain and function in patients. Magnetic resonance imaging is useful not only for diagnosis, but can also be used to assess the response to treatment of plantar fasciitis. Further studies are recommended to investigate and explore these findings.

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Lapidus Arthrodesis: Original or Modified. When To Perform It.

Ramiro Vera Salas

ABSTRACT

Arthrodesis of the joint between the first metatarsal and the medial cuneiform bones, also known as the Lapidus procedure, is an effective alternative for the treatment of severe hallux valgus, especially when associated with hypermobility in this joint. Cuneometatarsal hypermobility or instability is difficult to evaluate and is not a recent concept. Initially, it was evaluated mainly in the sagittal plane, but during the last few years new and better ways to objectify it have been reported, including in the coronal and transverse planes. Originally, Paul W. Lapidus described his arthrodesis as including cuneometatarsal fusion and the bases of the first and second metatarsals (original Lapidus). Over the years, modifications have been made including the addition of a plate to the cuneometatarsal fusion without performing arthrodesis on the metatarsals, known as the modified Lapidus procedure. The decision to perform one or the other procedure is closely related to the correct evaluation of stability preoperatively and intraoperatively. We present a clinical case of hallux valgus with instability of the TMTJ1 in which it was decided to perform the original Lapidus procedure with the aid of a medial plate that allows intraplate passage of the screw used for fusion of the bases of both metatarsals.

Keywords: TMTJ arthrodesis, hallux valgus, arthrodesis, cuneometatarsal instability, Lapidus.

INTRODUCTION

Hallux valgus affects 20%–35% of the adult population. Adequate treatment is vital due to the possibility of recurrence if the surgery performed is not correctly indicated.

In the early 20th century, fusion of the cuneometatarsal joint was described as an effective treatment alternative for this deformity. In the 1950s, Lapidus popularized his technique for the treatment of hallux valgus associated with hypermobility of the TMTJ1, but he only focused on evaluating it in the sagittal plane. He described his technique as using three screws to perform fusion of the TMTJ1 and between the first and second metatarsals.

Since its publication, several modifications have been made to the classic technique, transforming it into the "modified Lapidus" procedure that is most commonly used today. It consists of fusing the TMTJ1 with an interfragmentary screw and adding a plate that provides greater stability and can be positioned dorsally, dorsomedially, medially, or plantarly without fusing the first and second MTT. These modifications seek to improve the technique and reduce complication rates, mainly by improving union rates and reducing recurrences.

On the other hand, the current "original Lapidus" procedure includes the same as the modified Lapidus procedure, but adding the arthrodesis between the bases of the first and second metatarsal described in the classic Lapidus. When selecting it as a surgical option, it is essential to perform an evaluation in 3 planes – transverse, coronal, and axial – of the stability of the cuneometatarsal joint and thus decide which of the two techniques to perform.

This case study is relevant due to the difficulty in clinically determining cuneometatarsal instability and the fact that a complete evaluation and clinical radiological analysis of hallux valgus associated with hypermobility in the preoperative and intraoperative period are fundamental in deciding which surgical technique to perform and which implants to use, which ultimately influences the surgical outcome expected by the patient and the surgeon.

The objective of this case study is firstly to analyze the best way to evaluate the stability of the cuneometatarsal joint preoperatively and intraoperatively to determine when to perform the modified or original Lapidus procedure. Secondly, it also aims to address how to perform the original Lapidus technique when required and to define the best fixation method for it.

CLINICAL CASE

A 50-year-old female patient with the initials C. J. with a history of pain for several years related to right hallux valgus that presented on walking and wearing shoes. A long history of flat feet. Clinically full range of motion of the MTTF joint with a prominent, painful bunion and erythematous skin that bothers her when wearing footwear. Pain on palpation of the head of the second and third metatarsal and plantar hyperkeratosis. No pathology when using small orthotics. Asymptomatic flexible flat feet. An AP and lateral radiograph of the loaded foot was taken (Fig. 1) and moderate to severe hallux valgus was observed. Clinically, the stability of the TMTJ1 was evaluated and showed hypermobility in the sagittal and transverse planes. AP and lateral radiographs of the loaded foot showed a varus and pronated first metatarsal with lateral sesamoids.

Fig. 1

MANAGEMENT AND RESULTS

Due to these findings during the physical examination and radiology, cuneometatarsal arthrodesis with a Medartis medial plate, a 2–3 Weil osteotomy and Akin osteotomy were planned.
During surgery, a classic medial approach was performed between the MTTF1 and TMTJ1 joint followed by a bunionectomy and then cuneometatarsal arthrodesis. This entailed resecting the articular cartilage of the base of the first metatarsal and the medial cuneiform respectively and making a small wedge of lateral base. The articular faces of the fusion were prepared with A.K. 2.0 and the metatarsal was disrotated and fixed transitorily. Adequate clinical reduction was observed and it was fixed and compressed definitively with a 3.5 screw. Subsequently, a medial plate was added and fixed with wedge-locked screws, further compression was performed through the eccentric hole of the plate, and it was fixed with locked screws at the base of the metatarsal. Once the cuneometatarsal arthrodesis was completed using the modified Lapidus technique, stability in the sagittal plane and the position of the sesamoids were tested. A stress maneuver was performed to test stability in the transverse plane of the first ray. Persistent clinical and radiological instability was discovered in this plane, as shown in Fig. 2. Due to these intraoperative findings, it was decided to perform the original Lapidus technique. Consequently, the base of the first and second metatarsals were prepared respectively, the cuneometatarsal compression screw was removed, and a 3.5 screw was placed through the medial plate. This screw fixed both metatarsals in the correct position. The stress maneuver was performed again, and demonstrated total stability of the cuneometatarsal fusion this time in all planes (Fig. 3).


Fig. 2. Increased intermetatarsal space when performing a stress maneuver to test transverse stability.


Fig. 3. When applying the stress maneuver, correct stabilization is observed once the arthrodesis between both metatarsals has been performed.

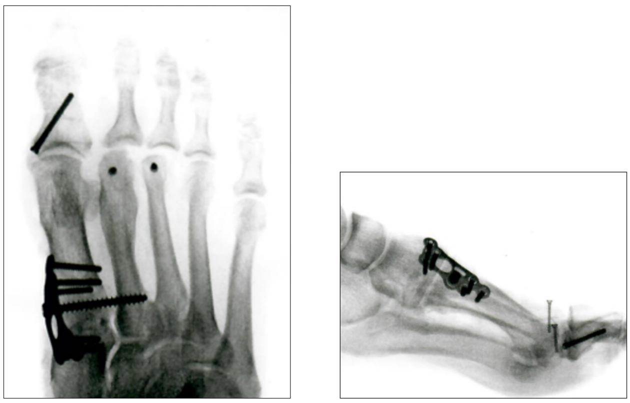
Fig. 4.

Subsequently, a Weil osteotomy was performed on the second and third metatarsals as well as an Akin osteotomy. With the bony remnants of these wedges, a graft was added to the arthrodesis between the bases of the first and second metatarsal to ensure fusion (Fig. 4).

Fig. 5. Stability evaluation maneuver in the transverse plane.

Fig. 6. a) Unloaded foot.

Fig. 6. b) Foot under load showing pronation of the first metatarsal.

DISCUSSION

When we are faced with patients with moderate to severe hallux valgus, it is of vital importance to evaluate the stability of the cuneometatarsal joint. This is difficult and a topic that is subject to much discussion. In the beginning there was debate over which came first: whether the instability led to hallux valgus or was a consequence of it. This evaluation mainly focused on the sagittal plane. In recent years, the perception that TMT instability occurs more in the transverse plane than in the sagittal has attracted more interest among researchers. This attributes more significance to the role played by changes found in the coronal plane related to pronation of the first metatarsal, which has led to a better understanding of the problem. There is now much literature attempting to address more fully the etiology and best solution for this pathology.

Current recommendations suggest evaluating stability in the three planes in the following order of importance: transverse, coronal, and sagittal. In the first plane, force should be applied to the first intermetatarsal space using the thumb and index finger. Having reduced and aligned both metatarsals, the instability would be positive if medial displacement of the first ray is perceived, it feels like the thumb and index finger are touching more closely, and there is a sensation of hypermobility in the cuneometatarsal joint using the index finger (Fig. 5).

In the coronal plane, the rotation of the first metatarsal can be assessed by looking at the pronation of the ray when the patient is asked to bear their own weight on the foot (Fig. 6).

Finally, in the sagittal plane, it is recommended to fix the medial wedge with one hand and perform dorsal-plantar translation of the base of the first metatarsal with the other hand. This is described as positive if a translation of 8–10 mm is verified. From the radiological point of view, to evaluate the transverse plane a loaded AP foot X-ray should be performed with and without tape that keeps both metatarsals aligned. In the loaded AP foot X-ray with tape the reduction and alignment of the two metatarsals can be observed, while the same X-ray without the tape will show the separation of the two metatarsals. For the coronal plane it is important to evaluate the position of the sesamoids in relation to the axis of the first metatarsal and the shape of the head of the first ray in the loaded AP radiographs, which provides an estimate of the degrees of metatarsal pronation. Finally, in order to evaluate sagittal stability, the loaded lateral foot X-ray may show a plantar opening at the cuneometatarsal joint and the extended position of the first ray, which would indicate instability in this plane.

Regarding intraoperative stability, the clinical maneuver described above must be performed to evaluate stability in the transverse plane once the modified Lapidus arthrodesis has been performed. If at this moment the maneuver is positive, the original Lapidus procedure should be performed. At this point it is important to remember that what should be performed here is arthrodesis between the bases of both metatarsals, since due to the mobility present here it is very likely that if only a screw is used to fix both metatarsals it will loosen, causing peritoneal osteolysis, or finally break. Both complications can cause pain and hallux valgus recurrence due to a failure to stabilize or align both metatarsals.

Regarding the surgical technique for this fusion between the bases of both metatarsals, it is important to prepare the bases in advance by resecting the cortex of both, reducing them, and fixing them with a cortical, ideally intraplate, screw to provide greater stability for the screw. In addition, a bone graft should be added to obtain a firm bone bridge that will provide the necessary fixation for our arthrodesis. It is therefore important to select the correct plate and plate position.

Multiple studies have already confirmed the advantages in terms of stability and union rates of medial and plantar plates versus dorsal or dorsomedial plates, which are not currently recommended. Some studies have concluded that although there are no differences in union rates between the plantar and medial plates, the plantar plate would provide biomechanical advantages by acting as a tension band. This would permit the patient to walk in the immediate postoperative period. With respect to medial plates, there are at least three known comparative advantages versus plantar plates:

- They provide a force that opposes the medial deviation of the first ray in cases of hallux valgus plus cuneometatarsal instability.
- They avoid manipulating the posterior tibial tendon insertion that some plantar or mid-plantar plates come into contact with.
- They provide the option of using a hole that allows a 3.5 screw to pass through the plate to fix both metatarsals. In the plantar plates it would have to be an extraplate screw.

The Medartis medial plate, which has a low profile, does not come into contact with the tendon insertions, provides extra intraplate compression, and has a hole for the passage of a 3.5 screw, is therefore an option to consider.

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In summary, it is important to know how to evaluate stability in all planes, to perform the intraoperative test, and, once the persistence of instability in the transverse plane has been determined after having performed the modified Lapidus, to make the decision to perform the original Lapidus. In that case, it is important to correctly select a plate that ensures medial support and to pass the screw that stabilizes both metatarsals through it.

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SWISS ORTHO CENTER

Basel, Solothurn, Switzerland
Schmerzklinik Basel, Swiss Medical Network
Fellowship director: Prof. Dr. Dr. Victor Valderrabano, MD PhD

The SWISS ORTHO CENTER supports musculoskeletal patients in the diagnosis and treatment of their diseases and puts them on the path to recovery to improve their quality of life, get back to work, and regain their sporting abilities with technical expertise, innovation, and humanity. The Foot and Ankle Center of the SWISS ORTHO CENTER is a prestigious center for foot and ankle surgery that is recognized nationally and internationally for its innovation and academic teaching and research. Post-traumatic, congenital, and acquired deformities in the foot and ankle area are treated in a way that is individually tailored to the patient based on the latest research findings and literature. The Foot and Ankle Center of the SWISS ORTHO CENTER is a center for the treatment of osteoarthritis of the ankle, specializing in the implantation of ankle joint prosthesis (total ankle replacement) or joint conservation through osteotomies and cartilage surgery. The Foot and Ankle Center has also gained international recognition for its sports orthopedics and treatment of sports injuries of the ankle and foot including osteochondral lesions, ligament lesions, tendon lesions (Achilles, etc.), and fractures. The Foot and Ankle Center of the SWISS ORTHO CENTER also treats arthritic conditions of the hindfoot, midfoot, and forefoot deformities as well as planovalgus, cavus foot, bunions, hammer toes, and others.

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Simultaneous Surgical Treatment of Posttraumatic Bilateral Temporomandibular Joint Ankylosis with Customized TMJ Prosthesis

Andrzej Jaxa-Kwiatkowski, Valfrido Antonio Pereira Filho, Mário Francisco Real Gabrielli, José Cleveilton Dos Santos, Mariana Dau Salmen, Ciro Mochizuki, Raphael Demarco

ABSTRACT

TMJ ankylosis is the fusion of the mandibular condyle with the glenoid fossa, impairing normal articulation and immobilizing the mandible. This can cause either partial or complete inability to open the mouth, resulting in functional impairment or growth deformities of the mandible. Ankylosis can occur in a simple fibrous restriction of jaw movement or can progress to bone formation within the joint, restricting movement completely. Both fibrous and bony adhesions restrict condylar translation thus limiting jaw mobility and function. In this article we present the case of a 63-year-old male patient with posttraumatic bilateral ankylosis of the temporomandibular joints. The patient suffered severe jaw injury after being hit by a motorcyclist at the age of 12 in 1970. He first attended the hospital due to a significant restriction in the mobility of the temporomandibular joints in 2017. Surgery was performed in the Hospital São Paulo - Unimed in Araraquara, Brazil, in 2021.

Keywords: Posttraumatic TMJ disorders, TMJ ankylosis, TMJ prosthesis.

INTRODUCTION

True ankylosis is caused by either fibrous or bony fusion of the structures contained within the TMJ capsule and, in its most severe state, is characterized by a bony union of the condyle to the glenoid fossa. True ankylosis can be subclassified depending on the anatomic positioning of the condyle and the extent of bone bridging.[1,4,7]

There is a three-stage classification to grade complete ankylosis, as follows:

- stage I, ankylotic bone limited to the condylar process;
- stage II, ankylotic bone extending to the sigmoid notch;
- stage III, ankylotic bone extending to the coronoid process.[12]

Ankylosis may lead to a chronic, persistent, and progressive inability to open the mouth, facial deformity, and obstructive sleep apnea–hypopnea syndrome.[1]

At present, surgical excision of the bone mass by gap arthroplasty is the only effective treatment approach to release the fused TMJ and relieve the clinical symptoms of TMJA.[2] However, this surgery is challenging and technically demanding because of the proximity to nerves, vessels, and skull base in this region. The results of experimental studies suggest that cartilage injury to the glenoid fossa might lead to fibrous ankylosis and bone injury to the glenoid fossa might lead to bony ankylosis under disc displacement conditions.[1,3] The etiology of TMJA is broadly categorized into traumatic injuries, infection, and previous TMJ surgery, but the reason for the propensity to develop TMJA is not known. It affects quality of life by interfering with mastication, speech, maintenance of oral hygiene, and poor esthetics.[5-7] Facial trauma is the most frequent cause of ankylosis, and common development of hematoma may eventually lead to its organization and ossification.[4]

The diagnosis of TMJ ankylosis is determined by clinical examination and imaging tests such as CT scans and magnetic resonance imaging (MRI). The ultimate goal in treating TMJ ankylosis is restoration of the function of the masticatory system with stable results, correction of the associated facial deformity, pain reduction, and prevention of re-ankylosis.[9,11]

Recent studies show a strong correlation between age at injury and prevalence and severity of TMJ ankylosis and the potential coexistence of facial malformations. Children have greater growth and reparative potential. The pediatric mandible has a broad condyle and thin cortical bone, which predispose children to intracapsular comminuted fractures. In contrast, the elongated condylar neck in adults usually limits fractures to the extracapsular space.[10]

Total joint reconstruction can be divided into autogenous replacement such as costochondral (CCG) and sternoclavicular grafts (SCG), or alloplastic reconstruction.[13] Surgical treatment of ankylosis of the temporomandibular joints is an extremely difficult procedure with many perioperative risks and the risk of recurrence, therefore it seems to be advisable to be vigilant and to make early diagnosis and prevent evolution towards ankylosis.[8]

CASE PRESENTATION

A 63-year-old patient suffered a jaw injury after being hit by a motorcyclist at the age of 12 in 1970. A radiograph was taken from the patient's report after the accident, which showed a jaw fracture. As the patient's medical history from this period is unavailable, there is no precise data on the course of the fracture fissures. Based on the clinical picture, we can assume with high probability that it was a fracture of both condylar processes in the mandible. Due to the limited availability of specialized treatment in Brazil at that time, the patient did not receive adequate treatment or rehabilitation of the temporomandibular joints. The trauma was accompanied by chronic pain, and a few years after the injury the symptoms were joined by severely restricted opening and closing of the jaws. The patient first came to the Division of Oral and Maxillofacial Surgery of the Araraquara Dental School (UNESP), São Paulo, Brazil in 2017 due to a significant restriction in the mobility of the temporomandibular joints. He had no outstanding comorbidities, but was a smoker and heavy drinker. Jaw opening decreased to 22 mm as measured from the remaining left canine to the edentulous mandibular ridge (presurgery Fig. 1–6).

Fig. 1–3. The patient's preoperative appearance.

Fig. 4. Intraoral view.

Fig. 5 Forced mouth opening.

Fig. 6. Intraoral jaw opening measurement.

MANAGEMENT AND OUTCOME

The patient was prepared for surgery to remove the ankylotic masses and reconstruct the joints bilaterally with a custom temporomandibular joint prosthesis. Computed tomography scans were obtained. The right TMJ showed signs of complete ossification, in the left TMJ a component of fibrosis was expected. Detailed planning of the procedure was performed with use of 3D technology. The planning and production of individualized titanium prostheses for the temporomandibular joints was commissioned to the company Traumec, Rio Claro, São Paulo, Brazil. The procedure was performed on November 3, 2021 in the Hospital São Paulo - Unimed Araraquara, Brazil. During the operation, neuromonitoring was used to minimize the risk of paralysis of the facial nerve. The main principles were satisfactory resection of the ankylotic segment and proper fixation of both parts of the prosthesis. The ankylosed mass was carefully exposed on both sides. The osteotomies and drilling were performed after fixing the preplanned rails and operating guides. A surgical splint was installed in the oral cavity to recreate correct mandibular positioning and interarch spacing, in order to allow subsequent prosthetic works. Intraoperative observation showed that the left disc was mostly intact, so it was reflected medially and used to protect the soft tissue structures medial to the mandible. Abdominal fat was collected from the suprapubic region for autogenous fat graft and packed around the prosthetic devices of both temporomandibular joints. All wounds were closed in layers and heavily dressed. The preoperative and postoperative course was uneventful. After surgery the patient was admitted to the ICU for postoperative care. He was kept in the hospital for seven days, mostly because he could not be trusted to take the postoperative antibiotics correctly and was discharged in good general and local condition.
We present below images of the ankylosed joints, treatment planning, surgery, and postoperative photos 15 days after the surgery. Partial paralysis of the marginal branch of the mandible of the right facial nerve was not avoided, but it is expected to be temporary due to the absence of severe damage displayed by the neuromonitoring. The postoperative view of the profile shows superficial soft tissue necrosis in the preauricular area on both sides, due to excessive manipulation and retraction, which is currently being treated (Fig. 7–43).

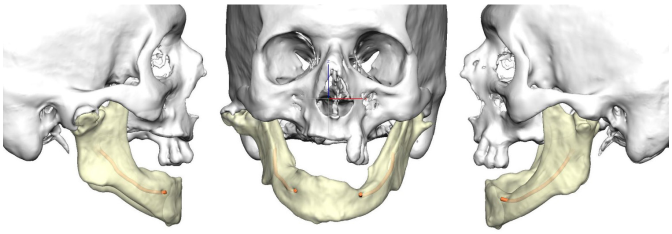


Fig. 7. Preoperative 3D reconstruction based on a CT scan.

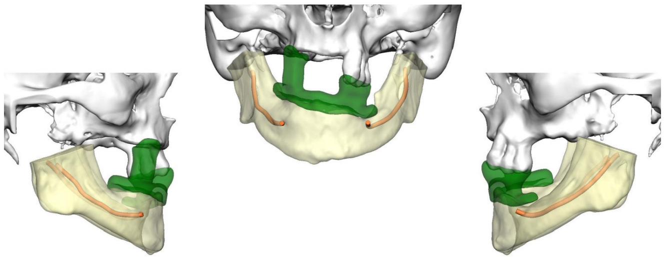


Fig. 8. Projection of the osteotomy along with occlusion guide splint.

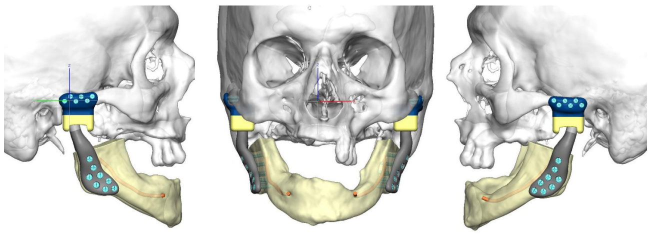


Fig. 9. Projection of the 3D planned prosthesis in its correct location.

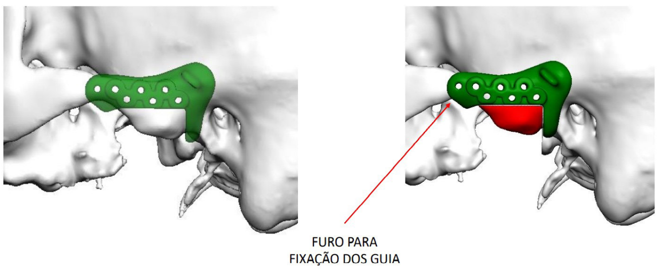


Fig. 10. Projection of the osteotomy guide along with the drilling guide at the zygomatic arch.

Fig. 11. Projection of the osteotomy guide along with the drilling guide at the ramus of the mandible.

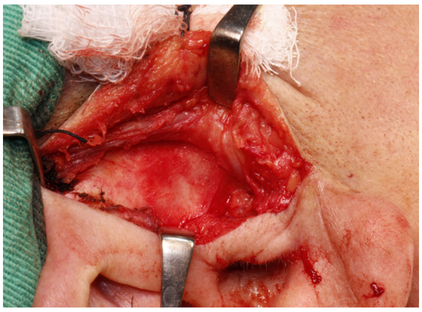
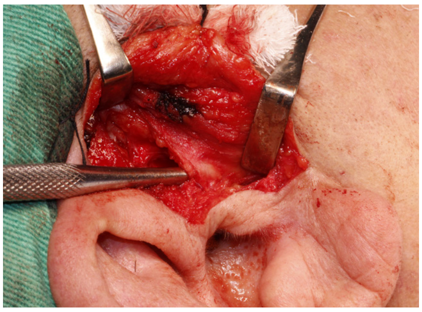



Fig. 12 and 13. Preauricular access to the ankylotic right TMJ.

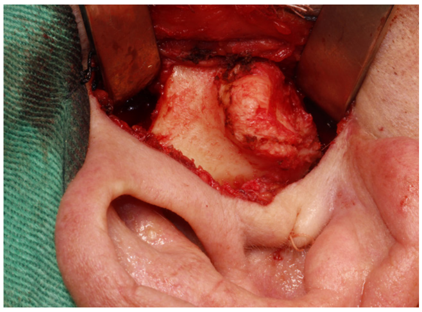


Fig. 14. Bony fusion of the structures contained within the right TMJ.

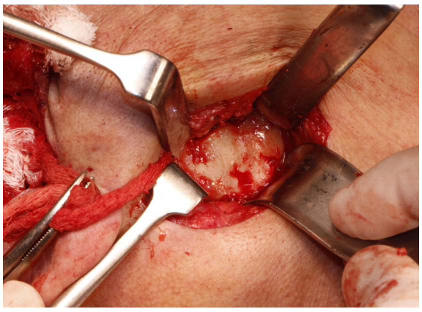


Fig. 15. Broad access to the right ramus of the mandible.

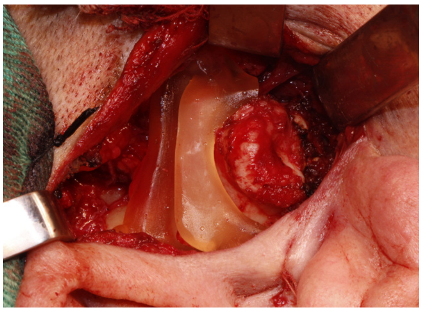


Fig. 16. Osteotomy guide installed correctly on the right zygomatic arch.

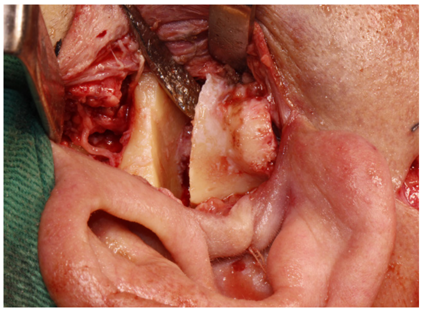


Fig. 17. Osteotomy of the ankylotic bone fragment.

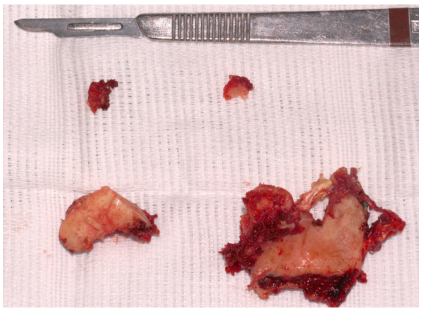


Fig. 18. Removed ankylotic fragments of the right TMJ.

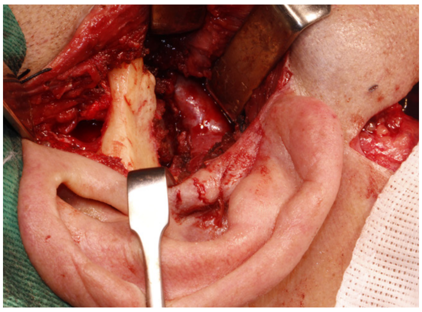


Fig. 19. Post-osteotomy view of the right TMJ.

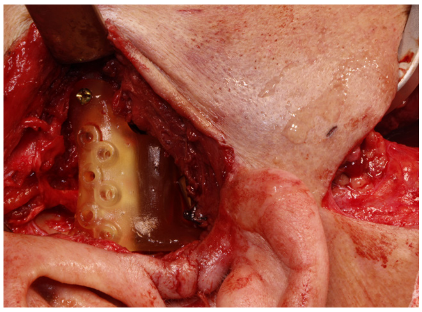


Fig. 20. Drilling guide of the articular fossa (right TMJ).

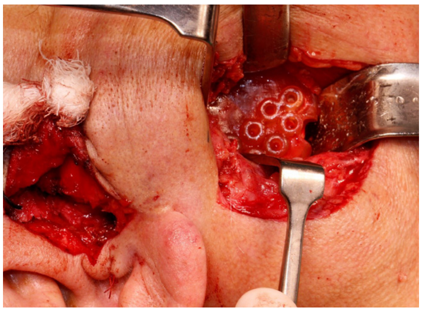


Fig. 21. Correctly fitted osteotomy and drilling guide of the mandibular ramus.

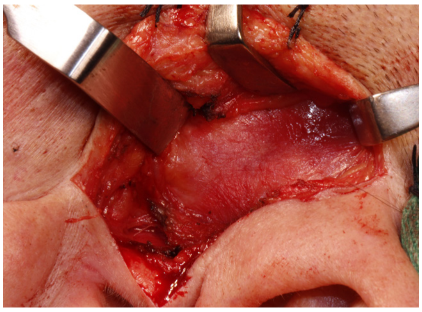
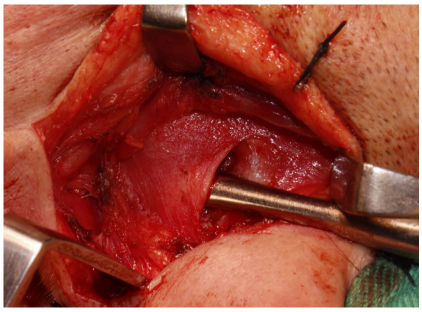



Fig. 22 and 23. Preauricular access to the ankylotic left TMJ.

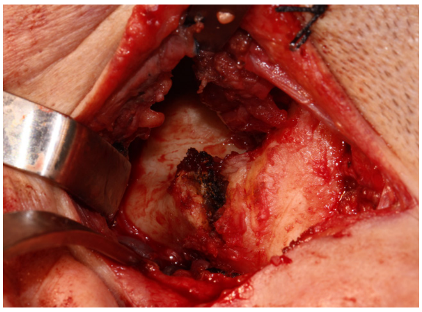


Fig. 24. Fibrous and partial bony fusion of the structures contained within the left TMJ.

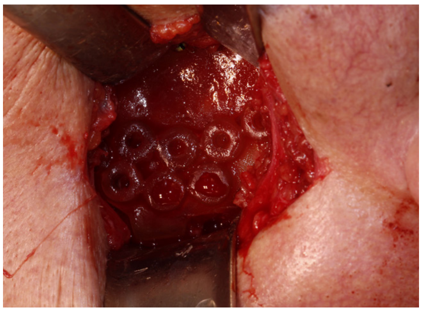


Fig. 25. Correctly fitted osteotomy and drilling guide of the mandibular ramus (left).

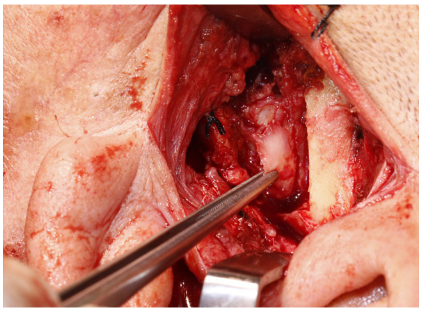


Fig. 26. View of the left TMJ after ostectomy with partially preserved joint disc.

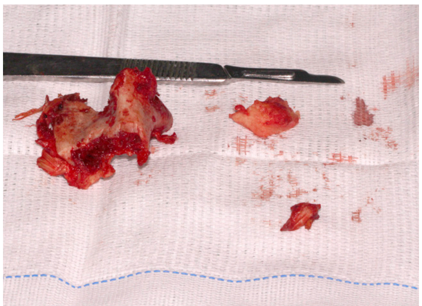


Fig. 27. View of an ankylotically altered fragment of the TMJ on the left side.

Fig. 28. Intraoperative jaw opening measurement.

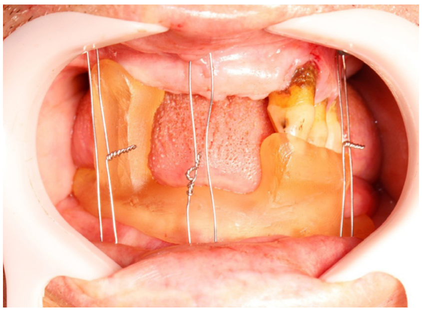


Fig. 29. Intraoral operating splints.

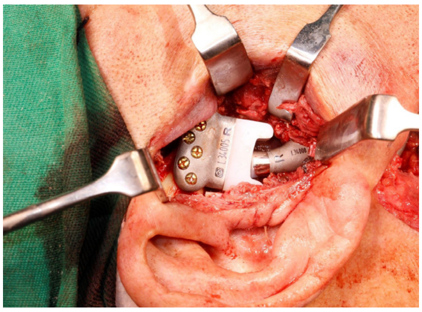


Fig. 30. Right-side articular fossa prosthesis fitting according to predrilled holes.

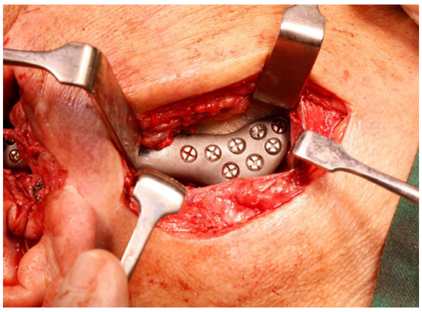


Fig. 31. Prosthesis fitting according to predrilled holes (right ramus of the mandible).

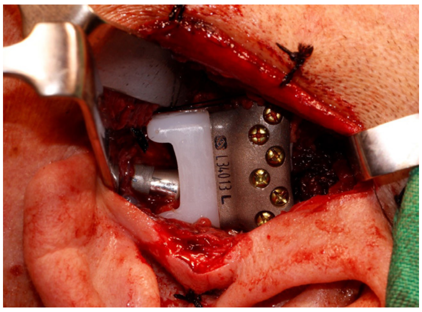


Fig. 32. Left side articular fossa prosthesis fitting according to predrilled holes.

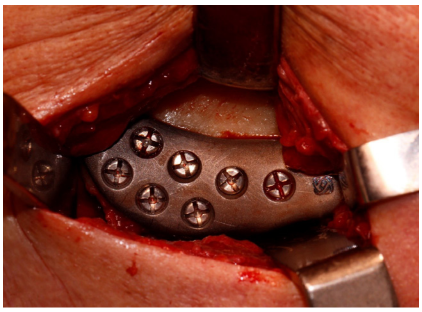
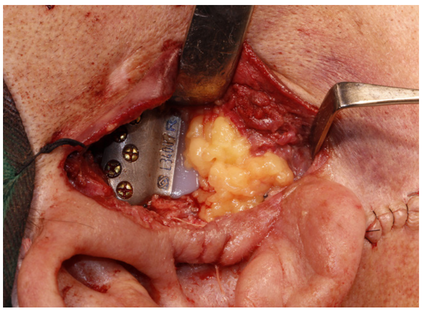


Fig. 33. Prosthesis fitting according to predrilled holes (left ramus of the mandible).



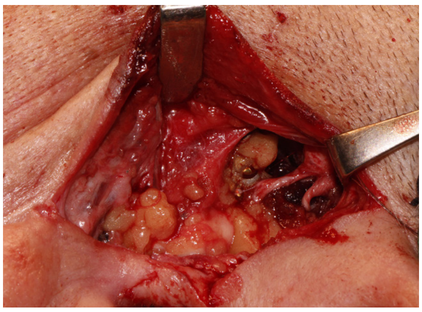


Fig. 34 and 35. Fat graft packed around the articulation area of the devices of both temporomandibular joints.

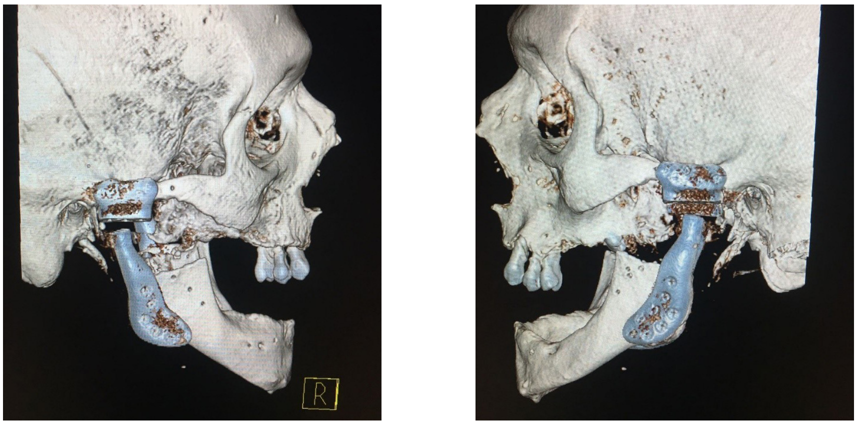


Fig.36 and 37. Postoperative 3D reconstruction based on CT scan (lateral view).

Fig. 38. Postoperative 3D reconstruction based on CT scan (frontal view).

Fig. 39, 40, 41. Patient's postoperative appearance.

Fig. 42. Fifteen days after the procedure (jaw opening measurement, 33 mm) before initiating active physical therapy.

Fig. 43. Postoperative intraoral view.

CASE DISCUSSION

One-stage removal of temporomandibular joint ankylosis and prosthetic reconstruction is an extremely complicated maxillofacial procedure. It requires the surgeon to have excellent knowledge of the anatomy of the affected area and experienced manual skills. The beautiful operating theater in the hands of wonderful Brazilian surgeons I had the opportunity to see enriched my perception of surgery. In the hands of experienced surgeons, even this difficult procedure looked easy. It is worth mentioning that the surgery went well due to the perfect planning of the operation and operating guides that meant the effect was more predictable. I would like to express my gratitude for the advice given to me and the time devoted to showing me the procedure step by step from the inside out, starting with planning and ending with postoperative care and the patient's follow-up visits.

Acknowledgment and References

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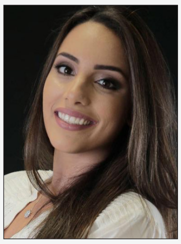

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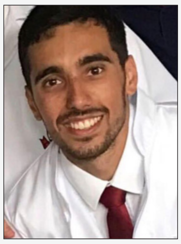

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The BioPro Thumb Carpo-Metacarpal Hemi-Arthroplasty: A Case Report

David Bodansky

INTRODUCTION

Arthritis at the thumb carpometacarpal joint (CMCJ) is common, affecting 33% of women and 19% of men, but is not associated with prior injury or occupation.[1,2] Excising the trapezium utilizing a hematoma arthroplasty, which was first described in 1949, provides good pain relief and function.[2] Concerns around thumb joint instability led to the addition of a ligament reconstruction and tendon interposition (LRTI), but work by Davis et al. showed that this did not confer significant clinical improvement.[3,4] Despite this, LRTI has remained a common additional procedure to a trapeziectomy. Patients return to most activity within three months of a trapeziectomy, although some patients can take much longer. In addition, concerns remain that after a trapeziectomy, there can be persistent weakness in thumb pinch and grip, thumb height shortening, and potential for thumb metacarpal collapse into the excised trapezium's space causing pain and adduction deformity. To address this, arthroplasty of the thumb CMCJ was introduced.

Thumb CMCJ arthroplasty may offer a quicker recovery and better grip strength,[5] leading to more normal function for higher demand patients. Initially, silicone spacers were used in the 1960s, but suffered early failure and extrusion. Monoblock polyethylene on metal cemented implants were later used in the 1970s, however since 1995, modular anatomical uncemented implants have been introduced and since 2012, dual mobility polyethylene liners have been used.[6,7] Evidence is still emerging as to whether trapeziectomy or arthroplasty provides better outcomes for thumb CMCJ arthritis. Head-to-head randomized control trials between the two interventions have not yet been conducted as thumb CMCJ arthroplasty remains an uncommon treatment. In addition, outcomes for thumb arthroplasty have not yet been published as dual mobility implants are still new and are not routinely submitted to national joint registries, such as the UK NJR, although are part of the British Society for Surgery of the Hand (BSSH) outcomes registry. Since 2015, thumb CMCJ arthroplasty has increased in Belgium and elsewhere in Europe, likely in response to newer prosthetic designs.[8,9]

Here, we present a case report of a newer option for hemi-arthroplasty of the thumb CMCJ.

Keywords: Total trapeziometacarpal osteoarthritis, trapeziometacarpal joint replacement, thumb carpometacarpal arthroplasty.

CASE PRESENTATION

A 74-year-old man presented with radial-sided thumb pain in his left non-dominant extremity. His pain was refractory to splinting and oral analgesics and he declined injections as they had been previously ineffective elsewhere. He wished to consider surgical interventions. He had no allergies and had controlled hypertension. Radiographs demonstrated osteoarthritis with joint narrowing and loss of height at the thumb carpometacarpal joint (CMC) (Fig. 1). However, the ST joint was preserved, and he had adequate trapezium depth to consider an arthroplasty (minimum 8 mm). Importantly, he also had SLAC wrist with radial styloid arthrosis on his radiograph.

On examination, he had squaring of the thumb base, was neurologically intact, and had normal wrist movements including dart thrower's movement. His pain was reproduced on grind test of the thumb CMCJ but was pain-free more proximally. In addition, he had no central or radial column tenderness and the Kirk-Watson test did not reproduce his pain, helping to discern between the two radial-sided pathologies of thumb – CMCJ arthritis and radial styloid arthritis. After exhausting non-surgical options and being counseled to his options, he decided on thumb CMCJ arthroplasty, to preserve thumb height and pinch and grip strength. As there was operating capacity, he was offered surgery the following day.

MANAGEMENT AND OUTCOME

The patient underwent a thumb CMCJ BioPro hemi-arthroplasty as an ambulatory procedure. The patient was brought on the morning of surgery to an ambulatory surgical center (ASC) and after re-confirming consent, underwent a regional block and sedation. He was positioned supine, with the arm on a radiolucent armboard (Fig. 2). A dorsal incision was centered over the thumb carpometacarpal joint, taking care to avoid branches of the superficial radial nerve. The EPB was mobilized and a longitudinal capsulotomy was made. The metacarpal neck was exposed, and a transverse cut with a saw made to resect the articular surface. Osteophytes were excised with a rongeur, with particular attention for any deep, hidden osteophytes. A burr created a central cavity in the trapezium, ensuring that the cortical wall was not breached. Then broaches were used to ream the metacarpal canal and provide a seat for the head of the implant in the trapezium. A trial implant was inserted, and the position assessed under fluoroscopy (Fig. 3). When satisfactory, this was replaced with the non-cemented implant and reduced, with confirmation of stability (Fig. 4,5). The capsule and dermis were closed in layers with 4-0 vicryl sutures and an occlusive non-absorbent dressing applied, with a bulky soft bandage and sling (due to the regional block).

The patient was discharged from the facility from the recovery area of the ASC. He was reviewed in clinic the day after surgery and began early hand therapy. He had sustained hand therapy, focusing on improving grip and pinch strength (Fig. 6). The patient reported that pain relief was immediate after surgery and that his range of motion and strength was excellent. The patient completed hand therapy over three months, with discharge from care at the three-month clinic review.

CASE DISCUSSION

Increasingly, patients have high expectations of function as retirement ages rise. This case has taught me that the indications for arthroplasty are for high- or moderate-demand patients. Arthrodesis is indicated for young manual workers and a trapeziectomy for older (or physiologically older) patients with lower functional demands. Outcomes for thumb CMCJ are good in the short term, but longer-term outcomes are yet to be published. If revision of the implant becomes necessary due to implant loosening, it can be revised to a trapeziectomy, or new implants may be inserted.

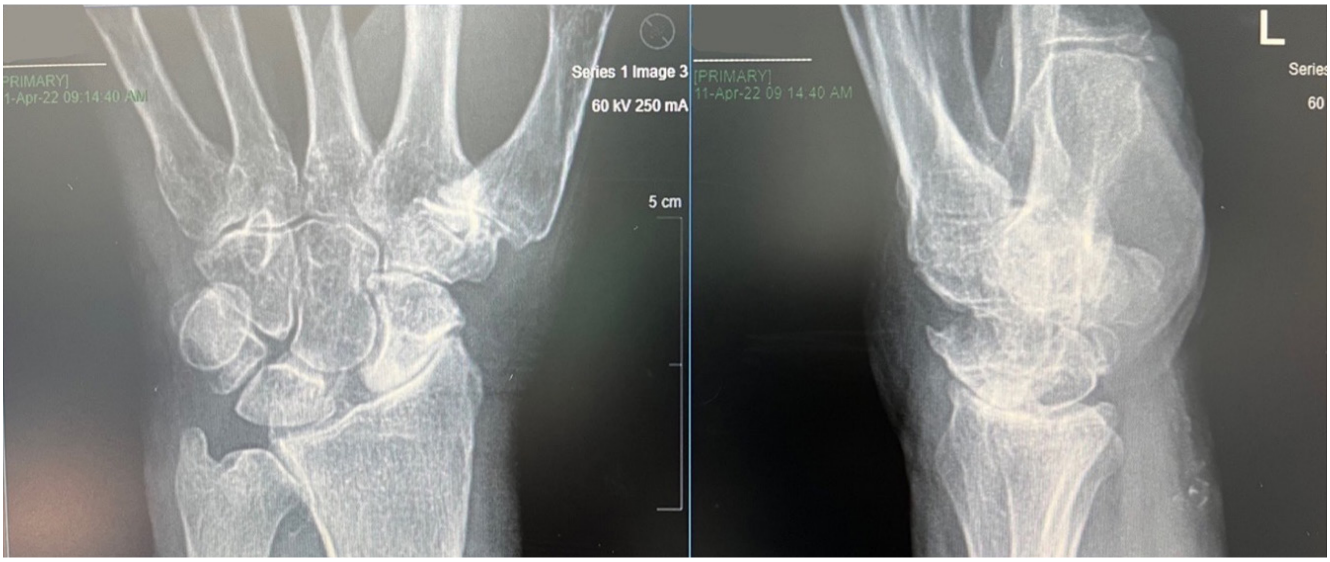


Fig. 1. Preoperative radiographs showing thumb CMCJ osteoarthritis and SLAC wrist.

Fig. 2. Operative set-up for thumb CMCJ arthroplasty.

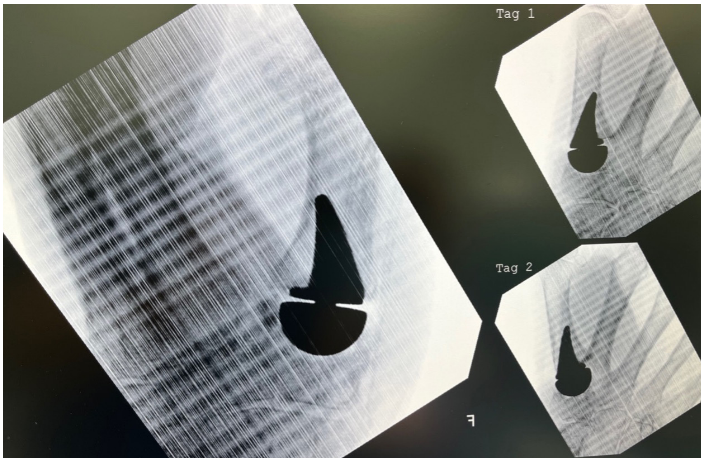


Fig. 3. Intraoperative radiographs showing implant position and the inbuilt varus attitude of the metacarpal prosthesis to adduct the thumb metacarpal.

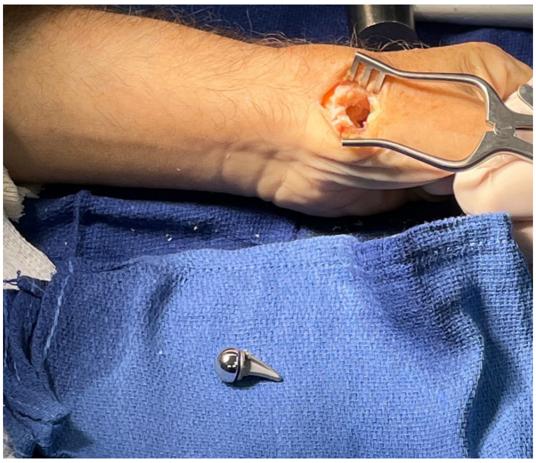


Fig. 4. Thumb CMCJ hemi-arthroplasty and incision.

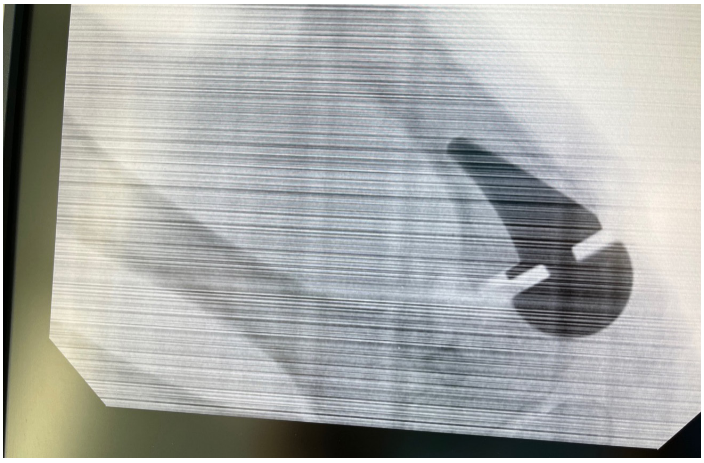
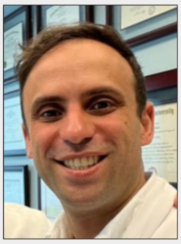


Fig. 5. Intraoperative radiograph showing that the radial cortex of the trapezium is important to prevent implant extrusion.

Fig. 6. Postoperative hand therapy turning different-sized objects in rice to provide resistance, building grip and pinch strength.

ABOUT THE AUTHORS



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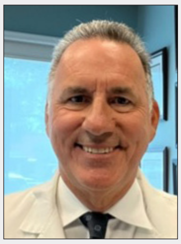

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Implementation of an "Extended Workbench" for Complex Corrective Procedures Using Rapid Prototyping Technology in the Upper Extremity at UKE, Hamburg

Konrad Mader, Julian-Elias Henneberg, Tobias Dust, Ralf Schumacher, Johannes Keller, John Ham

INTRODUCTION

Three-dimensional (3D) printing was invented over 35 years ago but has only recently started to be used in the medical arena due to the decreased cost and increased availability of printers and software (Fig. 1). It seemed a natural and necessary step to set up a 3D Center at University Medical Center Hamburg (UKE) with structural connections with the Department of Trauma and Orthopedic Surgery to provide modern patient treatment and teaching, perform basic and clinical research, and develop internal and external collaborations for the following reasons: The Department of Trauma and Orthopedic Surgery, the UKE (with its medical and legal apparatus) as a whole, and its international collaborators (i.e. the company Medartis and the OLVG in Amsterdam as a year-long collaborator with the corresponding author) would benefit from a "point-of-care 3D printer" for complex corrective procedures using rapid prototyping technology on the upper extremity at UKE. This long and difficult process can only be tested, simulated, and potentially finally implemented in an international network with collaboration between the UKE (with its huge medical and non-medical apparatus), a high-end medical company in the upper extremity sector, and an international partner (the OLVG in Amsterdam). In 2019, we therefore initiated this project to test the following hypothesis: can 3D printing with all its facets be incorporated into the Department of Trauma and Orthopedic Surgery of a university medical center?

CURRENT USE OF 3D PRINTING IN THE CORRECTION OF POSTTRAUMATIC DEFORMITIES IN THE UPPER EXTREMITIES AT UKE, HAMBURG

The first author started his initiation and education in complex corrections in the upper extremities with Prof. Dietmar Pennig, one of the great innovative trauma surgeons, who performed high volumes of corrective procedures in the upper extremity in Cologne, Germany. From there on he adopted several techniques to perfect those techniques, i.e., the use of programmable ring fixators and 3D printing techniques in both the planning and surgical execution of these operations. Since 2020 the senior authors have established a strong international collaboration with the OLVG in Amsterdam to perform a total of 155 corrective procedures in pediatric and adolescent posttraumatic and hereditary deformities in the elbow and forearm.[1-4]

In comparison with the era before the use of 3D printing techniques (before 2014), we now see higher patient satisfaction (due to better visualization of the deformity for correction for the whole team, Fig. 2), greater precision during the actual operation, and reduced operation time (due to the preoperative mounting of fixator devices, preoperative bending of plates, or even the use of patient-specific osteosynthesis plates, Fig. 3 and 4).

In addition, the use of 3D printing in deformity correction in the upper extremities has been tested for accuracy and efficacy both in-house and externally, and allows accurate correction while reducing the volume of blood loss and radiation exposure during surgery.[5-7] In 2021, 25% of surgeons are predicted to practice on 3D-printed models of the patient prior to surgery.[8]

Generally speaking, there are two main reasons why 3D printing is of utmost interest in the medical sector: the highly individualized 3D-printed patient-specific solution and the possibility to print highly complex structures serially (using parallel printing with more than 90 complex parts per print in house) using a variety of printing mediums (metal, polymers, ceramics, and even biological material, such as cells, both in industry and after transfer to medical research and practice). This makes 3D printing the most innovative method in modern patient treatment, teaching, and basic and clinical research (in the Department of Trauma and Orthopedic Surgery at UKE more than 10 projects are currently running using 3D printing techniques in both clinical research and student teaching). Since 2019 when the first 3D printer was acquired at the Department of Trauma and Orthopedic Surgery at UKE, more than 106 surgical cases have been performed using 3D printing techniques. Of those, 45 were models for visualizing the pathology for better surgical planning and patient-surgeon interaction, 25 were models for planning complex corrections using programmable external fixators, 22 were models in missed Monteggia pathology in order to simulate the corrective osteotomy of the ulna, 30 were models of fracture dislocations and complex fractures of the distal radius for team and student teaching, and 14 were full corrections using 3D printing techniques for deformity correction using printed templates (four of those were patient-specific implants). Two people (T.D. and J-E.H.) perform the sequencing and printing in addition to their daily work.

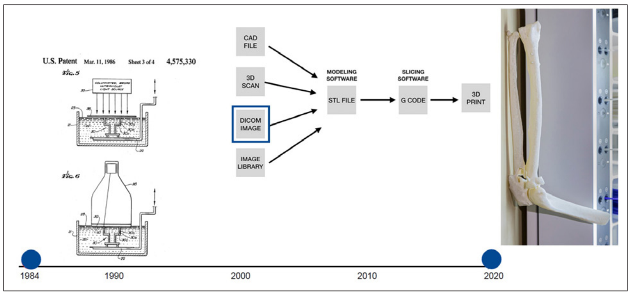

Fig. 1. Timeline of 3D printing in the medial field, with Chuck Hull's original patent drawing on the left, the procession of image files into a 3D print model in the middle, and a complex fracture dislocation of the elbow printed out at UKE, Hamburg on the right.

WORK ON THE IMPLEMENTATION OF AN "EXTENDED WORKBENCH" FOR THE USE OF RAPID PROTOTYPING BETWEEN UKE AND MEDARTIS

Both the Department of Trauma and Orthopedic Surgery at UKE and CMX Digital Solutions, Medartis, have been closely cooperating to create an "extended workbench" for the use of rapid prototyping. While the key people at UKE were working full force on the creation of a fully licensed 3D printing center at UKE, Hamburg (which was inaugurated a month ago), CMX Digital solutions have mastered several key steps for strong collaboration within the 3D printing sector. There is a full web-based interface for communicating image data, team meetings, and planning sessions (starting with maxillofacial and distal forearm corrections), there is ongoing bilateral communication on several projects, and, finally, a fundamental (IBRA-funded) project looking at the legal requirements for the use of rapid prototyping in corrections (as pars pro toto in the upper extremities) was undertaken with the following key findings:

- A 3D-printed patient-specific device is always a medical device with all the regulations that entails.
- They must carry a CE mark (again with all the regulations that entails including all the quality control steps).
- Using the "extended workbench" setup means that the hospital (here the UKE) will be a distributor of medical devices with all the regulatory burdens that entails.

Together with our international partner (the first corrections are planned for the end of 2022 after two hard years of Covid-related suspension of combined operative activity in Amsterdam), we will extend the implementation of the "extended workbench" scenario to a third partner. In addition, we will analyze the cost/benefit ratio of running a full functioning 3D Lab at a University clinic (and in fact are forced to do so by the medical administration) and will then evaluate whether some of the critical steps in the 3D printing process could be outsourced in due course.

Fig. 2. 3D-printed model of a complex forearm deformity (chronic missed Monteggia pathology) with severe valgus deformity. The forearm was printed in the "extended workbench" protocol together with Medartis CMX. The fixator was mounted preoperatively and demonstrated to the patient, and the duration of the operation was reduced by one hour.

Fig. 3. Preoperative debriefing of the operation procedure (left) and prebending of the plates used in the corrective procedure using 3D printed templates.

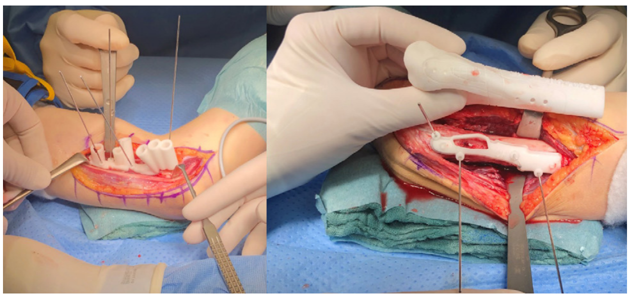

Fig. 4. Intraoperative images of the drill guide in situ (left) and intraoperative matching of a template to a 3D print of the actual deformed distal humerus with the plate marked on the model.

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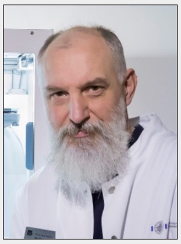

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The Sequelae of an Unrecognized Coronoid Fragment: A Case Report

Panagiotis T Masouros, Kilian Wegmann, Lars P Müller.

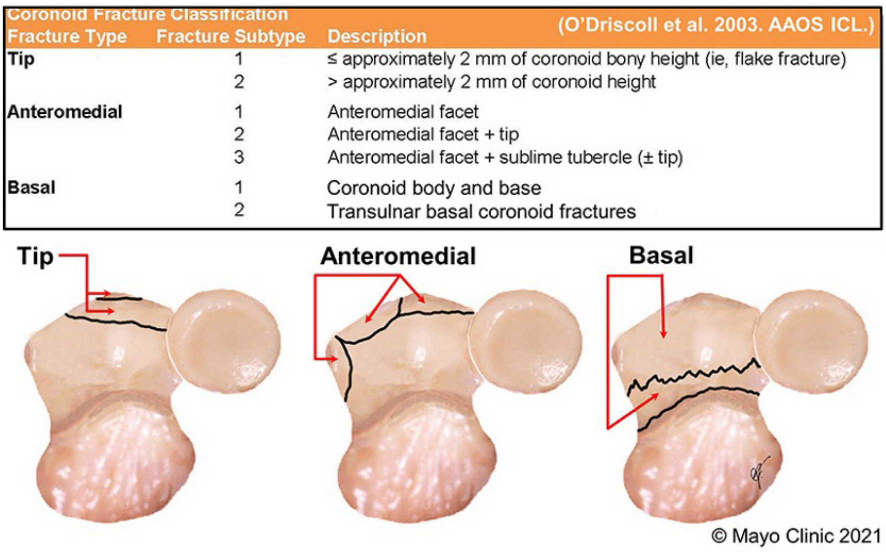
ABSTRACT

The coronoid process is a key structure of the proximal ulna, providing stability within the ulnohumeral articulation. Coronoid fractures usually occur in association with specific injury patterns. In this study, we report on a case of a missed coronoid fragment in a 66-year-old patient who had sustained a "benign" looking olecranon fracture along with a radial neck fracture. Significant instability after initial fixation with a dorsal plate was addressed by placing a bridging external fixator, furtherly complicated by iatrogenic radial nerve palsy. During revision surgery in our institution, the coronoid fragment was accessed and stabilized through a medial approach, thus completely restoring elbow stability over a full range of motion. The nerve was found to be entrapped by both humeral pins and was managed by primary repair. The lateral ulnar collateral ligament (LUCL) was found to be detached from its humeral origin and reattached with a bone anchor. This case implies that proximal ulna fractures can be considerably more complex than initial x-rays suggest. Subtle signs of instability can be present even in the absence of a true elbow dislocation and should be recognized preoperatively to avoid adverse complications.

Keywords: coronoid fracture, olecranon fracture, elbow instability, radial nerve palsy

INTRODUCTION

The stability of the elbow is primarily provided by the ulnohumeral articulation, the LUCL complex and the anterior bundle of the MCL. Secondary stabilizers include the radiocapitellar contact, the anterior capsule, and the common flexor and extensor tendons. Muscles crossing the elbow, such as the anconeus, brachialis, and triceps muscles can act as dynamic constraints.[3] Within the ulnohumeral articulation, the coronoid process is a key structure functioning as a bony buttress to posteriorly directed translation forces. O'Driscoll et al. have classified coronoid fractures according to their anatomic location, thus identifying three different types: 1) tip fractures, 2) anteromedial facet fractures, and 3) basal fractures (Fig.1). Each type is associated with specific fracture patterns and concomitant lesions: transverse tip fractures usually accompany terrible triads, anteromedial facet fractures are associated with varus posteromedial instability, while basal fractures occur in conjunction with trans-olecranon fracture dislocations.[5] All are well-recognized injury patterns accounting for the majority of traumatic elbow instability cases. However, traumatic elbow instability may be present even in more atypical fracture patterns.



Coronoid Fracture Classification (O'Driscoll et al. 2003. AAOS ICL.)

Fracture Type	Fracture Subtype	Description
Tip	1	≤ approximately 2 mm of coronoid bony height (ie, flake fracture)
	2	> approximately 2 mm of coronoid height
Anteromedial	1	Anteromedial facet
	2	Anteromedial facet + tip
	3	Anteromedial facet + sublime tubercle (± tip)
Basal	1	Coronoid body and base
	2	Transulnar basal coronoid fractures

Fig. 1. O'Driscoll classification of coronoid fractures.

CASE PRESENTATION

In this study, we report on a case of 66-year-old female patient who had sustained an olecranon fracture associated with an undisplaced radial neck fracture. Based on the initial X-rays, the fracture could be classified as a Mayo IIb since no apparent evidence of disruption of the ulnohumeral alignment is present (Fig. 2). The patient had undergone open reduction and internal fixation with an anatomical LCP olecranon plate in another institution. The injury on the radial side had not been addressed. After completion of the osteosynthesis, the joint was reported to be grossly unstable, and it was deemed necessary to place an external fixator over the elbow. After the patient's awakening, inability to extend the wrist and the fingers suggested an iatrogenic radial nerve palsy. Thus, the patient was referred to our institution (Universitätsklinikum, Cologne, Germany) for further evaluation and treatment.

X-ray and CT scans at our institution demonstrated a satisfying reduction of the olecranon fracture, but obvious signs of elbow instability probably due to escape of a missed coronoid fragment (Fig. 3). Neurovascular evaluation was suggestive of a high radial nerve palsy. It was decided to investigate the course of the radial nerve around the pin insertion area and then to stabilize the coronoid fragment through a medial approach with the LCP in place.

The external fixator was removed before draping, leaving the humeral pins in situ. Clinical examination under anesthesia revealed significant instability, as the elbow was being moved into extension. Initially, a skin incision was made on the lateral aspect of the distal humerus, focused on the site of pin insertion, in order to identify potential injury to the radial nerve. Indeed, it was recognized that the nerve was penetrated by both pins. The pins were carefully removed, leaving two lesions of 2–3 mm on the nerve. Since there was continuity of the majority of the fibers, it was decided to try a primary repair of the injured ones (Fig. 4a–b).

The coronoid fragment was accessed using an FCU split approach. A skin incision was made centered over the medial epicondyle and the ulnar nerve was identified both proximally and distally. The nerve was kept intact within its sulcus in order to avoid postoperative iatrogenic instability. The interval between the two heads of the flexor carpi ulnaris was developed providing access to the coronoid fragment (Fig. 5). Intraoperative manipulations showed that pronation of the forearm caused subluxation of the ulnohumeral joint, similarly to a varus posteromedial rotatory type instability.

Fig. 2. Initial X-rays: Note the presence of the unrecognized coronoid fragment (yellow arrow).

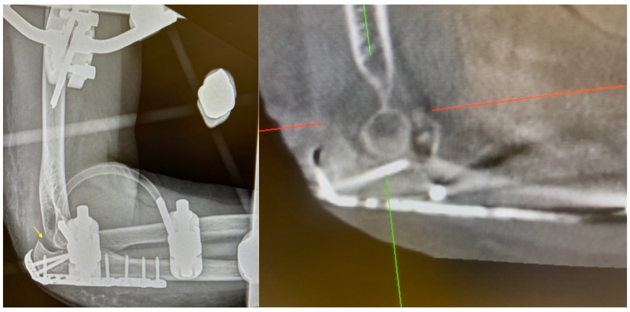


Fig. 3a, b. Postoperative X-ray and CT view after initial fixation. Despite the presence of hardware, ulnohumeral subluxation can be seen (yellow arrow) on the X-ray and escape of coronoid fragment on the CT.

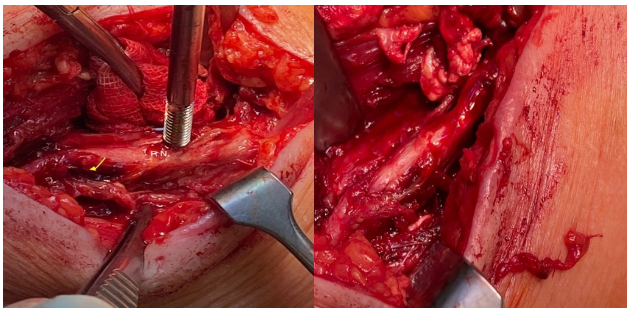


Fig. 4a,b. a) Intraoperative view of the pin penetrating the radial nerve. The first pin has already been removed leaving a hole through the nerve (yellow arrow). b) Radial nerve after primary repair.

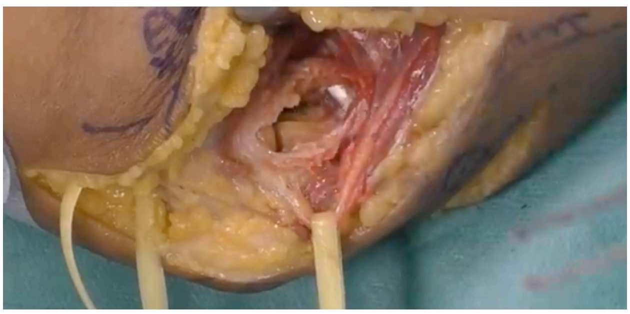


Fig. 5. Fracture site exposed through the FCU interval. Ulnar nerve recognized proximally and distally.

The fracture site was irrigated, and the coronoid fragment was anatomically reduced and provisionally stabilized with a 1.6 mm K-wire (Fig. 6). Then, a Trilock 2.0 coronoid plate (Medartis) was placed and secured using two screws both proximally and distally.
Clinical examination after coronoid fixation showed complete restoration of elbow stability over a full range of motion. The posterior band of the MCL and the origin of the flexor pronator mass were reattached to the medial epicondyle. Finally, a small skin incision was made on the lateral side centered over the radial head. Deep dissection revealed a detachment of the LUCL from its humeral origin. No motion was observed at the radial neck fracture site, suggesting fracture was healing in an acceptable position. A bone anchor was placed into the lateral epicondyle to reattach the LUCL. Subcutaneous fat and skin were closed in the routine manner. A functional brace with an extension block at 30° was placed, allowing for early protected range of motion. The patient was discharged two days later, while wound healing was uneventful. Routine follow-up after three weeks showed a congruent joint on X-ray (Fig. 7).

Fig. 6. Fluoroscopic image after preliminary reduction.

DISCUSSION

Proximal ulna fractures can potentially pose significant challenges to the surgeon, as they may represent only part of a more complex lesion. In many cases, the true extent of the injury may be underestimated, leading to poor treatment. The treatment goals should be anatomical reduction within the ulnohumeral joint and restoration of elbow stability. Identification of the fragments is a key element in achieving optimal outcomes. In this case, there were no apparent signs of instability on the initial X-rays except for the presence of a relatively small coronoid fragment. Inability to recognize this fragment and the concomitant LUCL injury has led to poor management and the necessity to place an external fixator. The postoperative CT, although limited by the presence of hardware, reveals subluxation of the ulnohumeral joint and escape of the coronoid fragment.
Coronoid fragments are associated with trans-olecranon fractures – dislocations are typically basilar and relatively larger in size. Thus, they can usually be secured with screws inserted through a posterior plate. In addition, the radial head and the collateral ligaments typically remain intact. On the other hand, posterior olecranon fracture dislocations may have more atypical fracture characteristics. However, they are characterized by disruption of the proximal radioulnar joint, thus belonging to the spectrum of Monteggia equivalents.[1] Our case cannot be classified as either of these two types: the fragment was considerably smaller and the fracture line extended into the anteromedial facet.

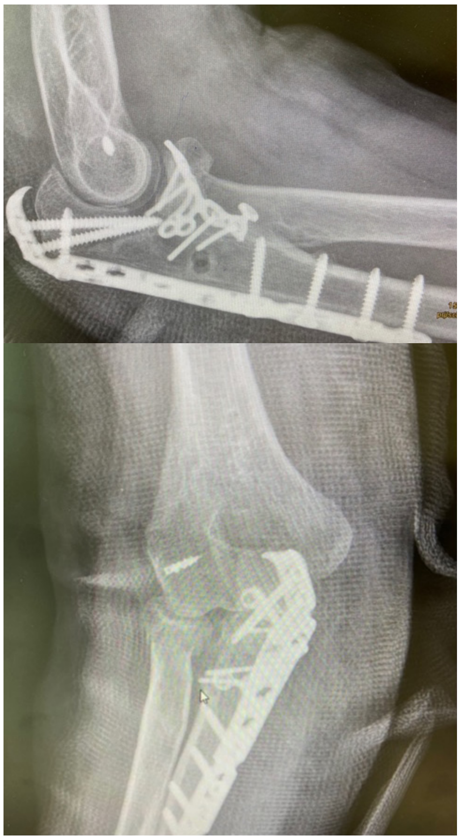


Fig. 7a, b. Postoperative X-rays showing good reduction of the coronoid fragment and joint congruency without signs of instability.

The latter has been the focus of interest of recent research, as it resists varus stress. Moreover, it is unsupported by the ulna metaphysis, thus being prone to fracture.[4] Biomechanical studies suggest that ulnohumeral posterior displacement does not occur if more than 50% of the coronoid height is maintained, given the collateral ligaments remain intact.[2]
The reason for selecting this case was to emphasize the fact that elbow instability does not always follow predictable injury patterns. Instability can accompany even more "benign" looking fractures without the presence of a true elbow dislocation. As mentioned previously, olecranon fractures can be only a part of more complex lesions, especially if the fracture line extends into key structures of the proximal ulna such as the coronoid or the crista supinatoris. A concomitant radial head fracture, ecchymosis on the lateral aspect of the elbow, or a small coronoid bony fragment are all suggestive of potential instability and should alert the surgeon. In any case, if persistent elbow instability is observed after olecranon osteosynthesis, the surgeon should be prepared to address any potential reasons, such as the coronoid, the LUCL complex, or the MCL. Most of these structures can be addressed through the posterior approach used for the olecranon fracture. Additionally, radial nerve palsy is an uncommon but potentially devastating complication of pin placement into the humeral shaft. Cadaveric data suggest that the nerve travels along the lateral aspect of the humeral shaft at an area of 6–13.5 mm as measured from the rotational center of the elbow.[6] However, there is a noteworthy variability in the course of the nerve and even a more proximal or distal pin insertion is not unlikely to injure the nerve. Thus, bridging external fixators over the elbow should only be reserved for those cases of persistent instability after having addressed all potential bony and ligamentous lesions.

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Overlooked Transscaphoid Perilunate Dislocation: A Topic Always on the Table

Jan Kudrna, Hermann Krimmer

ABSTRACT

A 34-year-old patient suffered a right wrist injury after falling from a bicycle. He was examined at the site of trauma surgery. Despite clear X-ray signs of serious injury – transscaphoid perilunate dislocation – including a spilled teacup sign that was not spotted, the patient was sent home with NSAID medication and an elastic bandage. He was informed by phone call the next morning that "something had been overlooked and that he should come to the Hand Center Ravensburg." The center was informed in advance that a patient with an overlooked perilunate dislocation would arrive. The patient arrived in the morning and the clinical examination revealed swelling, wrist pain, and increasing median nerve compression symptoms beginning at night. We proceeded with the surgical solution after performing the necessary preoperative procedures and supplemental CT examination, which excluded other bone lesions in the surrounding area apart from the scaphoid fracture in its middle third part. We first operated using the posterior approach and after performing an open reduction, stabilization of the fracture with a compression screw, and transfixation of the Lunotriquetral joint using two K-wires, we released the carpal tunnel using the anterior mini incision. Plaster fixation was applied postoperatively. Eight weeks later, fixation was released and the K-wires removed. The rehabilitation process then started. As in other cases of perilunate dislocations and subsequent treatment, permanent consequences can be expected in the form of reduced range of motion, weakened muscle strength, pain, and development of degenerative changes. However, with the correct treatment, anatomical reduction, and adequate stabilization there is a high probability that such permanent consequences can be avoided.

Keywords: misdiagnosed, overlooked transscaphoid perilunate dislocation, wrist dislocation, perilunate injury.

INTRODUCTION

Perilunate wrist dislocation is the most severe stage of perilunate injuries. The group of perilunate injuries includes purely ligamentous injuries from a scapholunate ligament lesion to a dislocation of the lunate associated with compression of the median nerve with or without a fracture of some of the adjacent bones. Mayfield divided perilunate injuries into four groups as early as 1980 based on a cadaveric study.[10] Although this is a well-known and much-discussed topic among experts, there are still cases where such injuries are overlooked at routine trauma clinics. Jesse B Jupiter reports that up to 25% of all perilunate injuries are missed during the diagnosis process.[4] Such an omission can have catastrophic consequences for both wrist and hand. It is therefore necessary to constantly draw attention to this topic to raise awareness of it among all doctors who encounter limb trauma.

The case below represents an example of overlooked transscaphoid perilunate dislocation that is hard to believe for a hand surgeon. Fortunately, thanks to the second reading of X-ray, the patient was informed of the diagnosis and sent to a specialized center where he could be adequately treated. The specific method of the ultimate treatment was, however, subject to discussion. Simple closed reduction and cast immobilization should be performed only when medical reasons contraindicate surgical intervention. Early reduction and cast fixation should be done until a CT scan and professional treatment is available. The treatment options include closed reduction and percutaneous fixation under arthroscopic control or open reduction and internal fixation. Despite the anatomic reduction and an early treatment of such injuries, the risk of range of motion and grip strength loss, recurring pain, and earlier development of degenerative changes is very high due to the extent of such injuries.[2,6,7]

CASE STUDY

A 34-year-old patient suffered a right wrist injury after falling off a bike at low speed. He was examined at a trauma surgery outpatient department. Probably due to a relatively low-energy trauma and insignificant clinical findings the patient was sent home only with NSAIDs and an elastic bandage, despite unambiguous X-ray signs of a serious injury – transscaphoid perilunate dislocation – including a spilled teacup sign that was not recognized. According to the patient, the wrist hurt but he considered it an adequate bodily response to the nature of the injury and did not attach much importance to it. The patient was informed by telephone the next morning that "something had been overlooked and that he should come to the Hand Center Ravensburg." The center was informed that a patient with an overlooked perilunate dislocation would arrive. The patient arrived the next morning as scheduled. The clinical examination revealed swelling, wrist pain, and gradually progressing paresthesia of fingers I–III, which most probably started to manifest during the night. When directly asked the patient stated the pain was manageable and he could sleep at night after taking ibuprofen 600 mg. CT examination was supplemented at a specialized department. Apart from the scaphoid fracture in the middle third part, which was already evident from the original X-rays, the supplemental CT examination precisely showed the carpal dislocation but no additional fracture. We operated using axillary plexus anesthesia, a tourniquet in a bloodless area, and initially utilizing the posterior approach. Using traction and a manual reduction the lunate with the proximal pole of the scaphoid was repositioned. The scapholunate ligament was intact. We performed scaphoid osteosynthesis after anatomic reduction with the cannulated compression screw from the proximal pole. Utilizing optical and X-ray monitoring, we reduced the lunotriquetral joint and stabilized it with two K-wires. In addition, we performed a median nerve decompression from the volar mini incision. Postoperatively, the patient received a plaster cast. By the first postoperative check-up, after the anesthesia plexus subsided, the paresthesia of fingers I-III had also already disappeared. Eight weeks later, the cast was removed, the K-wires were extracted, and rehabilitation was started. As in other cases of perilunate dislocations and their treatment, it is possible to expect a reduction in the range of motion and a weakening of muscle strength, pain, and earlier development of degenerative changes. However, due to the treatment performed and anatomical reduction and stabilization achieved, a much smaller range of negative consequences can be expected.

Fig. 1. Transscaphoid perilunate dislocation with a typical "spilled teacup sign".

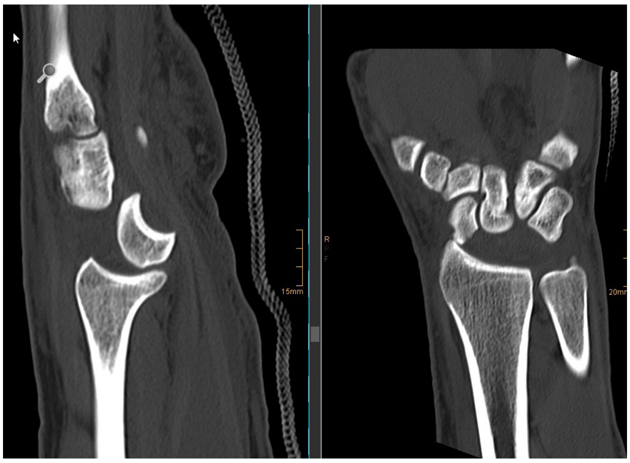

Fig. 2. Capito-lunate dissociation and a missing part in the proximal carpal row.

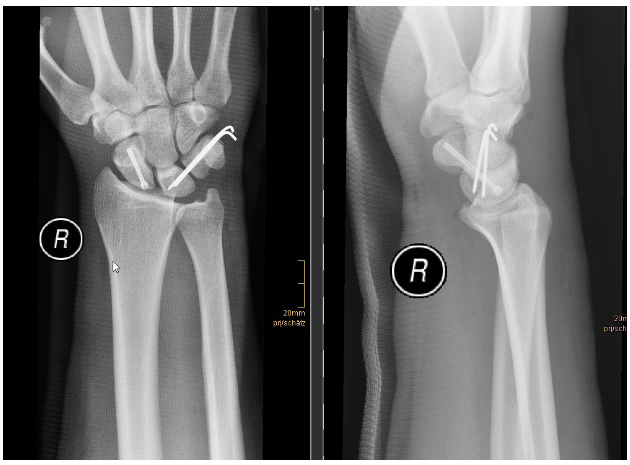

Fig. 3. 24 mm cannulated compression screw in the long axis of the scaphoid, transfixation of the lunotriquetral joint with two 1.6-mm K-wires, and restoration of normal wrist anatomy.

DISCUSSION

Neglecting any fracture or ligament injury and subsequent inadequate treatment can lead to pain and permanent limitations for the patient and subsequently to legal consequences for the professional at fault. This particularly applies to wrist injuries, especially in case of perilunate dislocations due to soft tissue devastation. Herzberg reports errors in the diagnosis of perilunate injuries,[3] Çolak then finds a causal link between the number of undiagnosed injuries and level of experience of the attending physician.[1] As already stated, it is therefore essential to constantly raise awareness about these not-so-rare injuries to ensure early diagnosis and appropriate treatment. Regarding the treatment method for perilunate dislocations, there is a clear consensus in the current literature on the need for immediate reduction and stabilization of individual components of the injury. However, current authors differ slightly in their preferred treatment method. This is either a closed reduction and arthroscopically assisted percutaneous pinning, which is highlighted by many authors,[8,12,13] or open reduction and internal fixation, which most authors still prefer. We believe that especially by using the approach of open reduction and internal fixation, we can achieve complete recognition of all bone and soft tissue damage, removal of interposed soft tissue and unstable chondral fragments, and can achieve accurate reduction of bone displacement and suture of repairable ligaments.[15] To reconstruct fibrous lesions the methods of direct suture and bone reinsertion are used,[14] and an internal brace treatment method has also been documented.[5] We do not use this method due to previous negative experiences with internal braces in SL ligament reconstruction. Regarding the surgical approach, the literature mentions the possibility of treatment from a) the palmar approach enabling treatment of the essential volar part from the LTq ligament,[9] b) the dorsal approach enabling direct visualization of treatment of dorsal part of the SL ligament,[6] or c) a combination of both approaches.[11,15] The studies available do not provide evidence that any of the treatments mentioned would significantly favor any one particular procedure.[11] It therefore depends on the personal preference of each surgeon to choose the approach that achieves optimal reduction, reconstruction, and stabilization of the individual components of the injury to reduce the frequency and severity of permanent consequences.[2,4,7] We usually start with the dorsal approach, which rarely has to be expanded with an additional palmar approach. Of course, if there are any signs of median nerve compression we open the carpal canal. however, if the carpus is severely destroyed and not reconstructable, a primary proximal row carpectomy can be performed as a salvage procedure.

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Having observed a number of perilunate dislocations performed by Dr. Med. Katerla over the last couple of months, I hold her in high esteem and would like to express my gratitude to her for the chance to participate in the treatment of such rare, but rather severe, injuries. I would also like to thank Dr. Med Katerla for her wise counsel and tips for improvement concerning the problems related to perilunate dislocations.

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Arthroscopic Lunocapitate Fusion Plus Scaphoid Resection in Patients with Midcarpal Arthropathy. Comparison with Open Lunocapitate Fusion Results through Literature Review.

German Carlos Funcheira, Pablo López Osornio

This retrospective study was carried out with patients who underwent surgery in the trauma unit between 2015 and 2022

ABSTRACT

Background: lunocapitate (LC) fusion has been shown to be a viable option for the treatment of carpal osteoarthritis, however, literature on this fusion using an arthroscopic technique is scarce.

Literature Review: We searched for published studies on LC arthrodesis with both open and arthroscopic techniques that reported on imaging and functional results.

Case Description: 17 patients (14 men and 3 women; mean age 43.6 years) with carpal arthropathy underwent arthroscopic surgery with radial styloidectomy, scaphoid exeresis, and lunocapitate arthrodesis with percutaneous compression screws between January 2015 and January 2022. The average follow-up was 44 months. Consolidation of the arthrodesis was confirmed in 16 cases. There was one case of pseudarthrosis, one of material migration and radial cartilage damage; this compilation was resolved with extraction of material, bone graft, and repair of the injured cartilage. Acceptable functional results were achieved at 12 weeks postoperatively. Satisfactory radiological and functional results were achieved in 15 patients, compared to the current bibliography, after performing the arthroscopic lunocapitate arthrodesis.

Clinical Relevance: The purpose of this study is to provide data (functional and radiological) from patients with SLAC or SNAC wrists who have undergone arthroscopic lunocapitate fusion and the postoperative results of their follow-up in our hospital. We will also compare these results with the current bibliography.

Keywords: coronoid fracture, olecranon fracture, elbow instability, radial nerve palsy

INTRODUCTION

Degenerative wrist arthropathy originated from carpal instability due to scapholunate dissociation (scapholunate advanced collapse or SLAC) or a carpal collapse due to scaphoid non-union (scaphoid non-union advanced collapse or SNAC), scaphotrapeziotrapezoid osteoarthritis advanced collapse (SOAC), scaphoid malunion advanced collapse (SMAC), or scaphoid chondrocalcinosis advanced collapse (SCAC) is a pathology that, as it develops, is clinically characterized by the presentation of severe pain and functional disability in the patient. In this situation, surgical treatment is indicated. Midcarpal fusion is a therapeutic alternative for the treatment of these arthropathies.[1] Its objective is to resolve painful symptoms, preserving the mobility of healthy joints. The latter has been objectified in different studies; wrist mobility is not exclusive to a single joint but rather the combination of movements of the radiocarpal and midcarpal joints.[2,3]
There are several options that appear when the midcarpal joint is already affected like the four-corner fusion (4CF) which fuses the lunate, triquetrum, capitate, and hamate or just the lunocapitate or LC joint.[1,4] By fusing fewer joints, greater soft tissue damage is avoided and therefore greater preservation of wrist movement is achieved.[2] Furthermore, LC fusion requires less operative time, with an easier and more reproducible learning curve. Recent studies have reached the conclusion that LC fusion can restore function and almost eliminate pain in wrists operated with this technique, with functional results and complications similar to those described in previous studies of 4CF.[4,10]
The above-mentioned procedures were described in the literature to be performed as open surgery and are commonly

carried out in this way; this requires extensive dissection and soft tissue damage, including the joint capsule and the dorsal carpal ligaments, to expose the surgical site. This could lead to iatrogenic joint stiffness, in addition to that already generated by carpal fusion. This is why in recent years it has been proposed to perform these techniques using arthroscopic surgery to try to minimize some of the complications that occur in the open procedures.[5] The wide intraarticular exposure of the wrist under the arthroscopic view allows a correct diagnosis of the structures involved in the arthropathy and, depending on what is observed, the surgeon can opt for one of several forms of partial fusion of the wrist.[6] In combination with a percutaneous fixation technique, arthroscopic partial wrist fusion can potentially generate a better functional outcome by preserving (with minimal surgical damage) the supporting ligaments and capsular structures and achieving maximum movement for each type of fusion because the effect of extra-articular adhesion associated with open surgery can be minimized. The lower aggressiveness of the procedure also reduces the inflammatory response of the tissues and postoperative pain, which favors rehabilitation. There is also a cosmetic benefit with a minimal surgical scar.

However, the literature on the outcome of arthroscopic lunocapitate fusion is scarce. Our objective is to compare the results obtained with our arthroscopic technique, contrasting them with those previously published.

CASE REPORT

The patients underwent arthroscopic lunocapitate arthrodesis with retrograde percutaneous compression screws, with exeresis of the scaphoid and radial styloidectomy. They were operated on by the same surgeon between 2015 and 2022. The visual analogue scale (VAS) was used, which is a unidimensional measure of pain intensity (before the procedure and after the procedure), and the range of flexion and extension of the wrist (before and after surgery), and the Mayo wrist score (Table 1) were also measured.

	AGE	SEX	PRE OP FLEX- EXT RANGE	POST OP FLEX- EXT RANGE	POST OP MAYO WRIST SCORE	PREOP EVA	POST OP EVA	TIEMPO MEDIO / F-UP
1	52	M	100	70	70	6	1	84
2	58	M	80	60	80	7	2	70
3	55	M	55	55	75	9	3	70
4	69	M	60	60	70	6	2	56
5	47	M	40	50	70	7	0	60
6	38	M	60	60	85	8	2	64
7	32	M	80	60	70	7	0	48
8	54	F	50	60	80	5	0	24
9	32	M	40	40	75	6	0	36
10	44	F	70	60	90	7	0	55
11	52	M	60	60	80	6	0	67
12	45	F	50	70	80	8	2	42
13	42	M	65	60	85	7	0	38
14	39	M	65	65	90	6	0	8
15	60	M	45	55	75	8	2	14
16	66	M	70	85	80	7	0	8
17	42	M	60	40	45	8	7	6

Table 1. Functional results and fusion consolidation.

Case of Favorable Evolution:

Malunion + Material Migration Case:

Material Failure:

DISCUSSION

LC fusion and the arthroscopic approach are gaining more and more followers. In the bibliography there are works on the subject; but in these the surgery used the open technique.[2,3] We did not find any with a series only of LC using the arthroscopic approach. There are reports of 4CF comparing open vs arthroscopic,[5] or case series of two columns and LC in this way.[6] The limitations of our study are related to the number of patients, the variation in their follow-up time (6–84 months), that it is a retrospective study without a control group, and that the compression technique used was not the same in all patients (with one or two screws). Arthroscopic LC arthrodesis is a demanding technique.[6] In our case series of arthroscopic lunocapitate fusion plus scaphoid resection in patients with midcarpal osteoarthritis, union was confirmed in 94% (16 of 17 wrists) of the patients, in an average of 1.5 months. These results are similar to those reported by Gaubier,[8] and slightly lower than Hegazy or Dargai,[7,10] in which all patients reported in their study achieved union. Our incidence of consolidation was higher than other previously reported series using the open technique.[3,9] In all these studies, compression screws were used as the means of osteosynthesis.

Regarding the Mayo Wrist Score that assesses pain, the active flexion/extension arc (in comparison with the contralateral side), grip strength (in comparison with the contralateral side), and the ability to return to regular employment or activities, we obtained an average result of 76.5, higher than others previously published,[3,9] but lower than Hegazy and Dargai who reported an average of 82.[7,10]

We also observed in the other publications cited an improvement in the average wrist flexion-extension arc in the postoperative period (from 1.1° to 19.9°) while in our study it decreased by 2.4°. We found no superiority in terms of postop VAS score compared to the other studies (Table 2).

Despite being a technically demanding approach, limited tissue exposure, less damage to capsular structures including dorsal carpal ligaments, smaller incisions, and better esthetic results are potential benefits over the open approach.[6]

Based on the above, we believe that lunocapitate arthrodesis for the treatment of midcarpal arthropathy, performed arthroscopically, is an option to consider once the technique.

	n	Union rate	Preop flex-ext	Postop flex-ext	MAYO	Preop VAS	Postop VAS	Average Follow-up	Non union	Material migration
Lopez Osornio	17	94%	61,8°	59,4°	76,5	6,9	1,23	44 months	1 (6%)	1 (6%)
Goubier	13	92,30%	59°	64°	not reported	7,3	1,25	29 months	1 (7,7 %)	not reported
Hegazy	12	100%	74,1°	75,2°	82,8	5,8	0,75	37,4 months	not reported	not reported
Yao	10	80%	61°	72,5°	70	5	1,1	44,5 months	2	2
Dargai	10	100%	60,6°	80,5°	82,4	5	1	122 months	not reported	not reported
Abdelaziz	15	87%	59,6°	70,1°	74,3	not reported	not reported	25,2 months	2 (13%)	not reported

Table 2. Comparison of functional results and fusion consolidation.

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The Use of a 3D Printer in an Upper Limb Surgery Department. Case: Scafolunate Ligament Lesion, RASL Procedure with a 3D Guide Pin.

Irigoitia Nicolas, Mantovani Gustavo

ABSTRACT

There are numerous uses for 3D printing technology in the field of medicine. The ability to create highly accurate 3D objects gives the physician several possibilities for the orthopedic management of patients, such as bone models for surgical planning, guides for osteotomies, percutaneous procedures, and specific orthoses. The cost of 3D printer equipment, supplies, and software are now less than a tenth of their initial cost, meaning that nowadays they are affordable for the average orthopedic surgeon. The most common uses involve complex cases, where bone deformities are tridimensionally difficult to understand intraoperatively and it is impossible to provide the expected accuracy using conventional surgical techniques, such as forearm deformities. Other frequent situations that require precision such as percutaneous fixation on the carpal bones can also be good indications. The 3D printing process starts with 3D digital planning of the surgery using 3D digital models from the patient's CT scans, and can be based both on the bones and soft tissues images. 3D planning is the most time-consuming step in the process, and its aim is to make the surgical procedure quicker and easier. To ensure a good outcome and successful planning, the physician involved in the process must have the appropriate surgical experience since this will be reflected in the virtual surgical procedure performed during the design step. The main purpose of this work is to show the advantages of using this tool on a common hand injury and a classical hand procedure, which could bring a novel outcome and new perspectives for its indications.

Keywords: upper limb, 3D printer, orthotics, 3D guide, minimally invasive surgery, percutaneous procedure.

INTRODUCTION

Operative treatment of scapholunate (SL) ligament disruption is often recommended to decrease pain and prevent a predictable degenerative progression to SL advanced collapse (SLAC).[1] Multiple procedures have been described in the literature, including ligament reconstruction,[2,3] dorsal ligament capsulodesis,[4,5] and carpal arthrodesis.[6,7] In 1997, Rosenwasser et al. described the reduction and association of the scaphoid and lunate (RASL) procedure, which aims to achieve a bony or fibrous link between the scaphoid and the lunate.[8] Initial reports demonstrated positive results at short- and mid-term follow-up.[8,9] An arthroscopically assisted technique was described by Aviles et al.[10] Subsequent outcome studies, however, have demonstrated poor results with an inability to maintain radiographic reduction of the scaphoid and a high reoperation rate.[11–14] Management of chronic SL instability presents a particular challenge to surgeons as the outcomes of various techniques have been inconsistent.[15] Rosenwasser et al. reported on 32 patients who underwent the RASL procedure and noted that only two patients required salvage procedures for progressive degenerative changes.[8] The authors noted maintenance of the radiographic reduction of the scaphoid and lunate. With the goal of creating a pseudarthrosis, there is preserved motion between the scaphoid and the lunate about the screw. As the wrist moves through the planes of motion, there is rotation, translation, flexion–extension, and radioulnar deviation that occur, which could theoretically cause a high rate of implant loosening.[16,17] Koehler et al. also attempted to describe the optimal technical considerations for the RASL procedure.[14] First, screw length and position were reviewed. They surmised that leaving one to two threads in the scaphoid cortex improved outcomes, thus requiring a longer screw. The authors further suggested that placement of the screw in the volar pole of the lunate along the proximal-ulnar corner provided the best fixation. For these reasons, precision for screw placement is essential. Through 3D models and the manufacture of guides, it is possible to plan the best placement site for the screw, in its axis of rotation, thus trying to avoid complications that occur due to site failure and screw placement.

CASE PRESENTATION

52-year-old male patient, physician, skilled right hand. He refers to a traumatic injury to his right wrist that had developed two months after a fall from his own height. It showed no improvement after one month of physiotherapy. At the consultation he presented dorsal scapholunate pain assessed as 9/10 on the Visual Analog Scale for pain (VAS), his motions were 40º flexion and 50º extension, both painful. His Mayo Wrist Score was 30 points. In the imaging studies, a scapholunate gap of 4 mm can be observed without signs of scaphoid flexion or extension of the lunate and without arthritic changes of the wrist(Fig. 1)

Fig. 1. Scapholunate gap of 4 mm can be observed, with no signs of scaphoid flexion, extension of the lunate, or arthritic changes in the wrist.

MANAGEMENT AND OUTCOMES

It was decided to perform a RASL-type procedure with arthroscopic assistance and 3D guides. A CT was carried out to obtain images for the design of the guide. The program used for the preparation and editing was mimic 3D (Fig. 2). It took 10 hours to edit. For printing, an XYZ printing pro 3D printer was used with PLA 2 material, which took six hours (Fig. 3). For the sterilization, 80% alcohol was used for one hour, with the placement of sterile covers for handling, as heat sterilization is not possible. For the surgical procedure, we proceeded in the usual way, with placement of a hemostatic cuff and 8 kg traction. When performing an arthroscopic examination using portals 3/4 and 6R, a joint inventory was performed, noting a complete lesion of the SL ligament and complete rupture of the dorsal intercarpal (DIC) ligament at its insertion on the scaphoid. We opted for debridement of the SL remnants and cleaning of the SL joint, and reinsertion of the DIC in the scaphoid with a 1.7 mm Arthrex Corkscrew anchor. Once this was achieved, the use of the guide continued. It was put in place and its alignment was checked (Fig. 4). The passage of the 1.5 mm system K-wire was made. With the subsequent withdrawal of the guide, its correct alignment was verified under fluoroscopy (Fig. 5). The drill passage of the system was performed, with subsequent placement of the 3.5 mm Arthrex screw that is 28 mm in length to achieve the RASL technique. After a second and final fluoroscopy check to verify the correct reduction, the skin portals were closed with nylon. Subsequently, a plaster splint was applied for two weeks. Total surgery time was 48 minutes and radioscopy time was less than one minute – only 47 seconds. After the stitches were removed in the second week, rehabilitation began with assisted passive mobility exercises. In his check-up at six weeks, the patient presented a VAS of 1/10, a mobility of 60º flexion, 70º extension, and his Mayo score was 90 points. The X-rays verified correct reduction and showed no sign of loosening (Fig. 7).

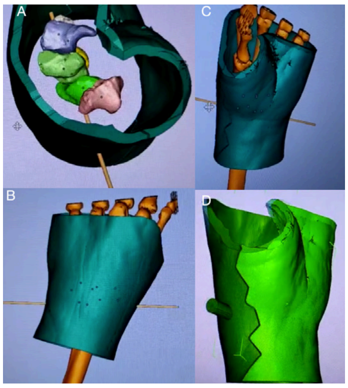

Fig. 2. 3D model design, with guide pin view (A–C). Final 3D model preprint (D).

Fig. 3. Final 3D printed model.

Fig. 4. 3D guide applied to the patient. After closure, it is firmly secured with a bandage.

DISCUSSION OF THE CASE

Advances in technology have helped to improve existing procedures and create new techniques. The incorporation of 3D guides into percutaneous procedures has made them simpler and leads to a more predictable prognosis. In this particular case, the value came from being able to experiment using 3D models to determine the best place for the implant. In addition, there was no need to adopt a dorsal or radial approach, arthrotomy, or styloidectomy, which makes the technique less aggressive and promotes faster recovery. This type of technique is also reproducible for other pathologies and the placement of other types of systems. I think it is a great tool that should be considered for future procedures due to the great value it can provide, as it can shorten surgery times and complications in different pathologies, both fractures and instabilities, and is not restricted to the upper limbs.

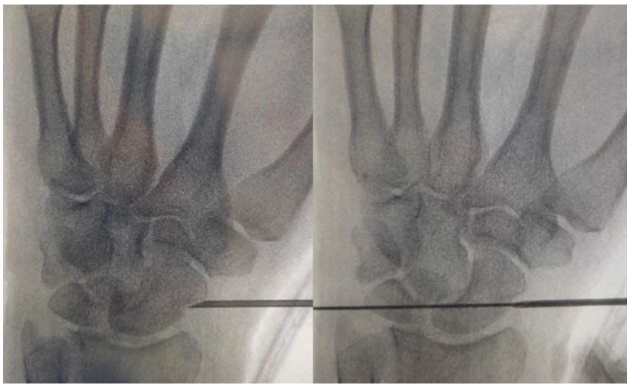

Fig. 5. The correct location of the abocath was verified with fluoroscopy (A). Subsequently, the K-wire was passed through it from the scaphoid to the lunate at the isometric point of movement (B).

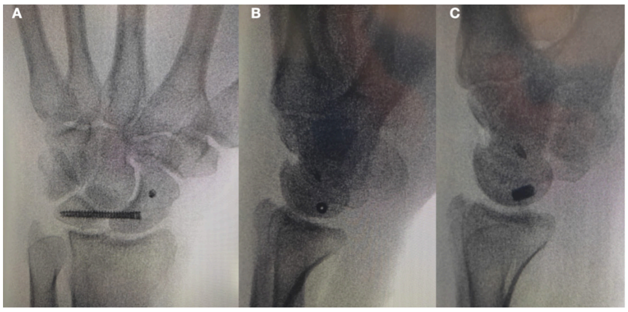

Fig. 6. Final radioscopy, noting the closure of the scapholunate gap and correct isometric alignment of the osteosynthesis.

Fig. 7. The X-rays verified the reduction was correct and showed no sign of loosening.

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Bilateral Volarly Displaced Shear Fracture of the Distal Radius: A Case Report

Renato Polese Rusig, Radek Kebrle, Martin Czinner

ABSTRACT

Distal radius fractures are the most common fractures of the upper extremity, with bimodal distribution, associated with high-energy traumas in the young population and low energy traumas in the elderly due to osteoporosis. The case presented in this study summarizes the treatment of a woman with bilateral volarly displaced shear fractures of the distal radius, both inherently unstable and with chance of a poor outcome if not properly recognized and treated.[1-9] Shearing fractures of the distal radius are rare, and few studies describe the assessment and results achieved by the most commonly used methods of fixation.[1] This pattern involves deforming forces and poor outcomes with non-surgical treatment that are better treated, in most cases, with early open reduction and internal fixation.[2] In this patient, both fractures were evaluated at the emergency department using radiographs and CT scans, classified, indicated for surgery, and operated on in a single procedure by hand surgeon Radek Kebrle, which achieved adequate reduction and fixation with a volar plate and locking screws. There were no complications in the first week after surgery.

Keywords: bilateral, distal radius, shearing, smith, Barton

INTRODUCTION

Distal radius fractures (DRF) are the most common fractures of the upper extremities. Their incidence is reported as 16 in 10,000, the distribution is bimodal, and it is most frequently seen in the young population due to high-energy trauma and in the old population after low-energy trauma. It is rarely presented as a bilateral fracture; they are seen only in 1.6% of DRFs from the national Swedish fracture register.[1] Probably because it occurs rarely, there is no consensus on the treatment of bilateral DRF or its management, and there is little interest in this peculiarity in patient treatment. Few articles have been published about this type of DRF.[3,4]

Volar distal radius Barton's fractures have been described as oblique fractures of the volar margin of the articular surface with carpus subluxation proximally and volarly within the volar fragment. It was previously believed to be a large single volar fragment, but in more recent studies it is more common to identify comminution of the volar fragment and dorsal cortical breaks, an aspect that changes the classification of the fracture from partial articular to complete articular (fracture line extending through the dorsal cortex of the metaphysis of the distal radius, reported in up to 75% of patients with a volar distal radius Barton's fracture).[5] This cortical break line can be missed on plain radiograph views, can be better analyzed with a CT scan, and is believed to be associated with more comminution of the volar fragment.[5]

The case report is about a 48-year-old woman who experienced a bilateral distal radius fracture with volar dislocation after a fall from her own height, presenting a dorsal cortical break, impaction of the articular surface, and loss of bony and ligamentous support due to the shearing forces involved on both sides. It is important to identify is a fracture has resulted from shearing forces because of their instability and risk of poor outcomes if an incorrect diagnosis results in delayed treatment of the fracture.[2,5,6] Addressing the fracture with only an "in-situ" buttress plate is not sufficient to restore the articular surface anatomy due to the flexion of both the anterior and dorsal rim fragments and the impaction of the articular surface. This may explain malalignments in some patients, especially when using an intentionally under-contoured buttress plate.[6] In Dr. Kebrle's opinion, a good intraoperative technique is to achieve precise contact and alignment of the metaphyseal fragments to the distal radius volar and dorsal diaphyseal cortices and use it as a reduction parameter to achieve the proper position of the articular surface and prevent volar carpal translocation.[7] In some cases, it may be necessary to raise the articular surface through the fracture and sometimes also use a bone graft to support the main articular fragments. There are many strategies that can be applied as fixation methods for volar shearing DRF, such as column specific plates, 1-hole plates and cancellous screws, volar-fragment-specific hook plates, and precontoured volar plates.[5,6,8]

Studying this specific case provides an overview of the changes in the assessment of volar dislocation shear fractures of the distal radius, which have evolved over the past 20 years with different classification details and fixation techniques.

CASE PRESENTATION

MD, a 48-year-old woman, suffered a bilateral closed DRF after a fall at her home from her own height with both arms outstretched on May 6, 2022. She went to the "Klinika Dr. Pirka" clinic and, in the emergency room, X-rays and CT scans of both her wrists were performed (Fig. 1, 2, 3, and 4), in addition to splinting and analgesia. Both fractures were classified as a Fernandez shear fracture/Volar Barton's/Smith type II, but her left wrist fracture also had comminution of the volar fragment and the above-described dorsal break. The treatment indicated was surgery for open reduction and internal fixation, scheduled for May 16. She waited for the surgery at home, and was admitted on the morning of the surgery and stayed in hospital for one more day after the procedure. Before going home, she was told the basics of postoperative care, to rest, to use the splints on both wrists until the day of her next consultation, to take painkillers if necessary, and to return in a week for wound care and in two weeks again to remove the stiches.

The patient reported a lot of pain at the moment of the injury, improving only after the immobilization of both wrists in the emergency room. The patient was afraid of feeling pain again after surgery, but Dr. Kebrle explained what to expect after surgery, and that there would only be mild pain thanks to the anesthesia. She was confident about the treatment and had time to ask questions about it before the procedure.

The physical examination of her wrists by the time of the surgery presented minor swelling, probably because of the preoperative splinting and that she stayed at home and rested as instructed. She also had no nerve palsy and no associated injuries.

In the radiographs of the left wrist, it is possible to evaluate the fracture as a result of shear forces throughout the volar rim, the long axis of the wrist is volar to the long axis of the radius, and there is comminution of the volar fragments and loss of radial height. In the sagittal plane of the CT scan of the left wrist, the dorsal break line is visible, as is the impaction of the central articular fragment, the size of which can be estimated with the axial view and is considered one of the main fragments.

The radiographs of the right wrist show a volar shear fracture of the distal radius, the carpi is subluxate to anterior and proximally to the radius axis, it is possible to see a dorsal break line but there is less comminution of the volar fragment. In the right CT scan, the fracture presents less comminution, bigger fragments, and less impaction than compared to the left wrist fracture.

Fig. 1. Left wrist radiograph – front and lateral views.

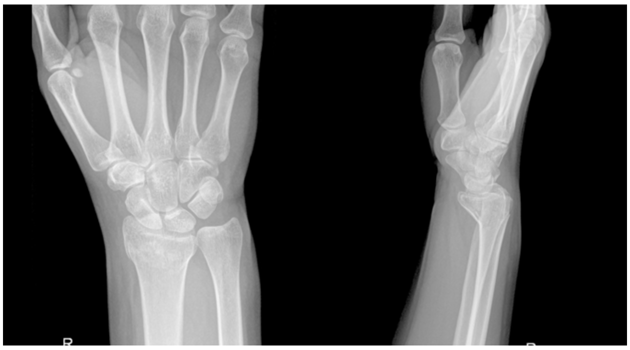

Fig. 2. Right wrist radiograph – front and lateral views.

Fig. 3. Left wrist CT scan – axial, coronal, and sagittal views.

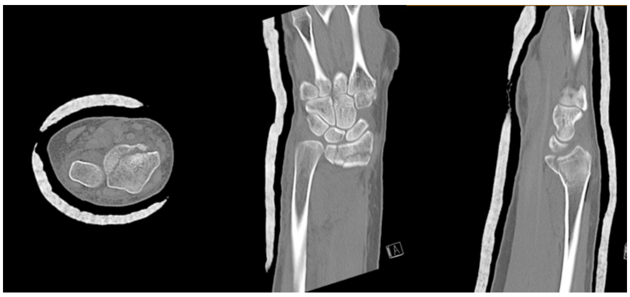

Fig. 4. Right wrist CT scan – axial, coronal, and sagittal views.

MANAGEMENT AND OUTCOME

On May 16, the patient was admitted to hospital in the morning and was operated on under general anesthesia and a bilateral regional block with Marcaine and Mesocain for pain relief after surgery. Both forearms were prepared and sterilized with the patient in a supine position. Dr. Kebrle began the surgery from the left side using the modified Henry approach for the distal radius to access the fracture. The open reduction maneuvers were focused on the elevation of the central fragment and regaining the articular surface anatomy and the radial height. It is a common error to keep the dorsal rim fragment in flexion after the reduction of the volar rim, resulting in malunion and making it impossible to achieve the proper reconstruction of the articular surface, so care was taken intraoperatively to achieve extension of both the volar and dorsal rim fragments and the reduction was confirmed by fluoroscopy. Also with the aid of fluoroscopy, a Medartis precontoured volar plate for the distal radius was used for fixation of the fragments. We proceeded with the closure of the wound with intradermal sutures and on to the surgery of her right wrist, with the modified Henry volar approach. As soon as we reached the radius, we identified the volar rim fragments and performed the reconstruction of the articular surface. It was much easier on the right radius because the fragments were bigger and there was less comminution. A precontoured Medartis volar plate was used for fixation after the reduction under fluoroscopy, the implant and screw positioning and length were checked with fluoroscopy, and the wound was closed with intradermal sutures. We also applied a sterile bandage and splinted her wrists. There was no need to supplement the fixation method with any other hardware.

The patient stayed in the hospital until the next morning for pain control and recovery from the anesthesia, and faced no complications during her stay in the infirmary. X-rays were performed the next morning (Fig. 5 and 6) and she was able to go home as planned, with the prescription of painkillers and information about bandage and wound care, and instructions to return for consultation in one week. One week after surgery, the patient came to the hospital to have her dressings changed, remove the splinting, and to begin hand therapy of the fingers and MP joints. The next week she came to have the stiches removed and to improve the hand therapy, beginning to work on the range of motion in her wrists. No complications had been identified by that point and pain control was effective with medication.

Fig. 5. Postoperative left wrist radiograph – front and lateral views.

Fig. 6. Postoperative right wrist radiograph – front and lateral views.

CASE DISCUSSION

The case presented in this study is that of a woman with a bilateral distal radius fractures with volar and proximal dislocation of the fragments and the carpi, a rare condition that lacks literature to provide a treatment protocol. An appropriate assessment of the fracture in the emergency room (splinting, pain control, instructions to the patient to rest, and correct identification of the severity of the fracture) is of major importance to reduce swelling, provide local conditions for early open reduction and internal fixation of both sides, and to reduce the chances of complications during the whole treatment. The surgical indication in this case was both because of the described instability of volar Barton's/Smith type II fractures and because she had a bilateral fracture. A well performed surgery provides the proper reduction of the articular surface and internal fixation, and when accompanied by immediate hand therapy after the procedure, helps ensure a fast recovery and return to work.

The healing process is not yet complete, but up to the end of my fellowship the treatment has been a success in my opinion considering the severity of the fractures. Treating both sides with one single operation with adequate reduction can ensure healing and a good outcome for the patient. It could only be achieved because of the attention to detail and the care taken to avoid pitfalls during the preoperative, intraoperative, and postoperative periods. More research and larger series are needed about bilateral DRF treatment outcomes, volar shearing dislocation fractures of the distal radius, and the importance of the dorsal break line in this type of injury, to provide literature to support timing, strategies for surgery, and ensure better results.

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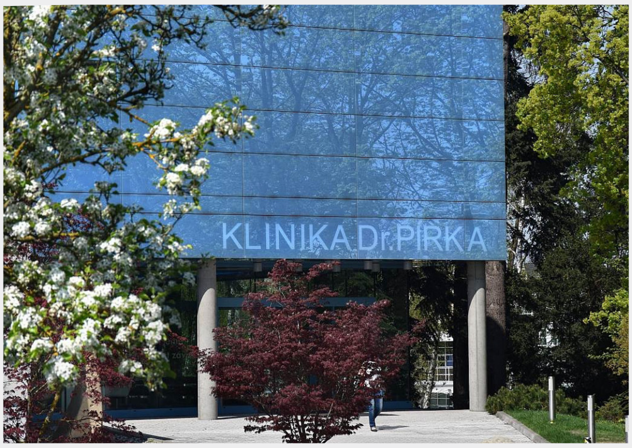

Klinika Dr. Pírka Mladá Boleslav is a private surgical facility founded in 1920. It focuses on general surgery, orthopedics, and hand surgery. Hand surgery has been performed at Klinika Dr. Pírka since 2002, when the hospital started to offer specialized hand procedures concentrated mainly on wrist arthroscopy and hand and wrist arthroplasties. At the end of 2019, a special Hand Surgery Unit was set up to cover all hand surgery subspecialties except spastic hand deformities. Nowadays we have five hand and upper limb surgeons. Two of our physicians are shoulder surgeons and three are dedicated hand surgeons performing hand and wrist surgeries. It covers arthroscopies, joint arthroplasties, trauma and sports injury reconstructions, posttraumatic reconstructions, peripheral nerve surgeries, systemic arthritis surgeries, degenerative condition treatment, and congenital hand anomaly treatment. Two members of the team are European Hand Diploma holders (Dr. Radek Kebrle – Best Candidate 2009, Martin Czinner – Best Eastern European Candidate 2020).
The facility also plays a role as a referral center for other facilities all around the Czech Republic and in nearby countries. This activity covers a large number of complex hand and wrist cases. Procedures based on 3D planning and 3D printing in wrist and forearm reconstruction are an important part of the hand surgical program as well.

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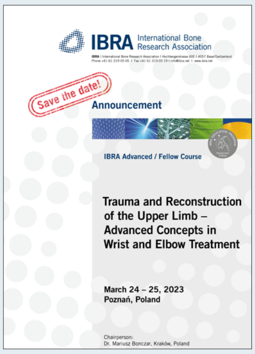

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