7TH ANNUAL GLOBAL DIGITAL SURGERY MEETING

OCTOBER 7-8, 2021

VIRTUAL EVENT

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Hosted by:

TECHFIT
Digital Surgery

Welcome!

Good morning everyone,

It is my honor to have you as guests at the 7th Annual Global Digital Surgery Meeting. Technology is changing everything we do, we now can watch whatever we want on-demand irrespective of TV schedules, we go to the bank on our mobile phones. We can check the menus in all restaurants in the area and order our dinner without leaving our couch, new things that we didn't even know we needed are being created every day to solve life's problems.

Healthcare is not immune to this trend, today the vast majority of patients search their symptoms online before visiting a medical professional, they have the unprecedented ability to network with other patients and discuss treatment options, evaluate professionals, evaluate devices, and pharmaceutical companies. Technology is also disrupting therapeutics; 3D printing has made it possible to perform practice operations on complicated patients before actually operating on them. The implants and instruments used on the surgery can be custom crafted for that specific patient and that specific procedure. AI is empowering the surgeon's ability to diagnose and treat diseases in a faster, more effective manner. All these technologies will grow exponentially and before we know it, they will become mainstays in every OR and Medical Office. If you think back to 10 years ago, you would never have thought that you could place long-distance video calls from your mobile phone for almost free.

The technologies that will do this are being created, step by step, and are used to improve patient outcomes and experiences every day. We consider it our duty to help orchestrate an interdisciplinary community that fosters constructive academic discussions and innovations so that all the new advances can be used to achieve the one thing all of us in the Healthcare sector want: To make patients better again.

Thank you for choosing to be a part of this community and I am certain your participation in this discussion will enrich the conversation and spark the initiatives that will allow a brighter future with better healthcare for everyone.

Sincerely,
Mauricio Toro
CEO
TECHFIT DIGITAL SURGERY Inc.

Academic Committee

MAXILLOFACIAL SURGOEN

Dr. Arango is a Dentist and Oral and Maxillofacial Surgeon who specializes in oncology and complex reconstruction. He earned both his degrees in the CES University in Medellin, Colombia. He has had his work presented in numerous national and international congresses including the Colombian Association of Oral and Maxillofacial Surgeons, The AAOMS Annual Meeting and the European Congress for Cranio-facial surgery. He has significant experience with the reconstruction of mandibular and maxillary cancer patients by means of a free fibula flap and has used 3D technology in more than 80 of these cases, which he has been following and publishing.

Dr. Coathup qualified in Medical Cell Biology from the University of Liverpool, United Kingdom in 1992. She completed her Ph.D. in 1999 at the Institute of Orthopaedics, Division of Surgery and Interventional Science, University College London (UCL) based at the internationally leading Royal National Orthopaedic Hospital in Stanmore, UK. She became an Assistant Professor at UCL in 2001 followed by an Associate Professor before becoming Head of the Center for Tissue and Cell Research at UCL and Divisional Head of Athena SWAN and Women in Science in 2014. In October 2017, Dr.Coathup joined the College of Medicine, University of Central Florida as Professor of Medicine and Director of the Biionix Cluster. Over the last 24 years, Dr. Coathup has worked in Biomedical Engineering and orthopedic innovation with the view of investigating and applying scientific discovery to improve the treatment and care of patients. During her career and in collaboration with fellow scientists, clinicians, engineers, and orthopaedic manufacturing companies, her research has focused on improving orthopaedic implant fixation and enhancing bone regeneration, focusing on translational themes that include biomaterials, stem cells, the design and follow-up of implants, implant infection and novel synthetic bone graft substitute materials. Her research excellence has been recognized internationally through her publications and through receiving several prestigious UK, European and International prizes from her peers.

PROFESSOR OF MEDICINE

Academic Committee

PROFESSOR OF MECHANICAL ENGINEERING AND CHAIR OF THE DEPARTMENT OF MECHANICAL ENGINEERING, ERAU

Dr. Divo currently serves as Professor and Chair of the Department of Mechanical Engineering at Embry-Riddle Aeronautical University (ERAU). He completed undergraduate Degrees in Mechanical Engineering and Information Engineering from the Central Technological University (UNITEC) of Venezuela in 1992 as the top of his class honored as the Valedictorian. He completed multiple graduate Certificates and Degrees in Statistical Control from ITESM as well as an M.S. and Ph.D. in Mechanical Engineering from the University of Central Florida (UCF) in 1998, achieving a perfect academic grade-point average (4.0/4.0) throughout his graduate studies. Dr. Divo is actively involved in Biomedical Engineering Research including Cardiovascular Hemodynamics, Lung Dynamics, Hip Mechanics, Muscle and Tissue Mechanics, Radiotherapy, and others. His fundamental research concentrates on the development of Mesh-Reduction techniques such as Meshless Methods and the Boundary Element Method aiming at generating automated numerical solutions of field problems in the areas of Fluid Dynamics, Heat and Mass Transfer, Porosity, and Elasticity, as well as the multi-physics interaction of these phenomena in a number of ensuing applications in the Biomedical field. He has co-authored over 250 articles including over 80 peer-reviewed Journal papers and two technical books. He was awarded a Patent by the USPTO for a Dilator Device for Percutaneous Tracheostomy. His research has helped him attract over $4.0 million in funding from State agencies, Federal agencies, and private industry. He has taught over 30 undergraduate and 8 graduate courses and has supervised 17 M.S. Theses and 10 Ph.D. Dissertations as well as over 30 Senior Design Projects and Honors in the Major Theses. He has received multiple awards such as the 2001 Pi Tau Sigma UCF Professor of the Year, the 2007 UCF CECS Teacher of the Year, the 2009 E-Week Central Florida Engineer of the Year, the 2009 UCF CECS Distinguished Researcher Award, the 2008 Teaching Award and the 2009 Research Award by the State of Florida University System, the 2014-2015 ERAU College of Engineering Research Award, and in 2014 he received the National Education Award from the Hispanic Engineer National Achievement Awards Corporation (HENAAC) at the Great Minds in STEM (GMiS) conference. He is a Fellow of the Wessex Institute of Great Britain and a Member of the Editorial Board of the Journal of Engineering Analysis.

Keynote Speakers

Mauricio Toro

CEO/Co-Founder of Techfit Digital Surgery

Mechanical Engineer from National School of Engineers of Metz, Master in Computer-Aided Mechanical Design, and Master in Advanced Automotive Engineering from the University of Cranfield University. Currently, he is the Chief Executive Officer of Techfit Digital Surgery in Daytona Beach, Florida. He has more than ten years of experience in the health sector.

Dr. Abdul Hameed Attar

Oral and Maxillofacial Surgeon

Dr. Abdul Hameed Attar is a consultant in Maxillofacial surgery at Wockhardt Hospitals Mira Road in India. He works as an accredited trainer in custom-implant designing and surgical planning and has substantial experience handling serious maxillofacial trauma cases, and patients with cancer of the oral and maxillofacial areas.

His experience covers temporomandibular joint surgery (TMJ) for correcting malfunctions of the joint as well as pain, dental implants, facial augmentation (chin & chin), and Facial Cosmetics.

Industry Presenters

Jan Hertwig

Simulation-Based Workflow for Preoperative Planning of Surgically Assisted Rapid Maxillary Expansion

Martin Herzmann

3D printing of patient-specific cranial PEEK implants, Regulatory pathways, pay-per-part, saving potentials

Randy Rowell

New Product and Procedural Justification Navigating the financial review of Supply Chain, Purchasing, and Procurement

Alexander Volf

Digital Verification of Custom Implants Using Numerical Simulation

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Posters

Carlos Yepes, MD, BME

From virtual computing and mental computing to computing in the surgical space. How the brain adapts to the "virtual"

Dr. José Manuel García y Sánchez

Le Fort IV Osteotomy or Le Fort III Tessier VII Osteotomy in Adults

Dr. Juan Gabriel Loreto

Pierre Robin sequence; Total Bilateral Temporo Mandibular Joint Replacement Comprehensive treatment. Clinical case. (English)

Presentation Abstracts

UTILITY OF 3D TECHNOLOGY IN PREOPERATIVE PLANNING OF SOFT PART TUMORS

Authors: Andrés Balaguer Román, Juan Angel Fernández Hernández, Noelia Ibáñez, Mª Dolores Frutos Bernal, Beatriz Gómez Pérez, Pedro José Gil Vázquez, Valentín Cayuela Fuentes, Ana Delegido García.

Introduction

The evolution of medical imaging technology has made it easier to obtain better and more accurate anatomical images, which has greatly improved preoperative planning. In the case of complex surgical interventions, especially those that involve three-dimensional anatomical spaces with multi-organ involvement, the use of 3D models, which accurately replicate the patient's anatomy, allows the surgeon better planning than that achieved with the information provided by the techniques.

“conventional” or “planar” imaging, anticipating intraoperative adverse events and resulting in a decrease in complications.

OBJECTIVE

To determine the clinical utility of the use of 3D models in complex surgeries.

MATERIAL AND METHODS

All cases in which 3D models were used prior to surgery in the Sarcomas and Mesenchymal Tumors Unit were retrospectively reviewed. The review spanned between January 2015 and March 2021. Clinical, surgical and pathological variables were collected from the identified patients. Likewise, and in order to assess the usefulness of the 3D models by the surgical team, a survey was completed where the preoperative usefulness, precise time for obtaining it, cost and anatomical precision of the 3D molds were scored between 1 and 10. . This survey was addressed to all service members who had had contact with these patients and had the opportunity to learn about this technology.

RESULTS

Twenty-four patients were identified, 17 men (70.8%) with a mean age of 53.13 +/- 15.6 years, corresponding to 15 sarcomas, 4 retroperitoneal lymph node metastases from testicular germline tumors, 4 giant lipomas, and 1 locally advanced GIST. Their mean size was 11.6 cm and regarding the locations, 8 were located at the retroperitoneal level, 7 in the pelvis, 2 at the axillary level, 2 in the lower limbs, 2 at the supraclavicular level, 1 in the groin, 1 in the rectum and another at the subscapular level. The survey revealed that the cost (1.7 points) and the precise time for its elaboration (2.2 points) are the main handicaps of this technology which, on the other hand, is very anatomically precise (8.2 points) and very useful from the point of view of preoperative planning (8.7 points).

DISCUSSION-CONCLUSIONS

3D printing technology has seen its use increased exponentially in recent years. The main advantage of its use is focused on improving surgical planning, both pre and intraoperative, in the field of oncological surgery. The main limitations to its use focus on the time it takes to make the molds as well as the cost of this technology. The use of 3D models in highly complex oncological surgery allowed a very detailed understanding of the anatomical relationships of these tumors, which favored better planning of their surgical approach.

CURRENT TECHNOLOGY INTEGRATED INTO ORBITAL TRAUMA

Author: Luis Gonzalez DDS
Oral and Maxillofacial Surgeon
Hospital Universitario La Samaritana Bogota Colombia

Introduction

The reconstruction of the orbit has been carried out throughout history using different techniques. However, the persis- tence of high rates of complications mainly associated with the position of the eyeball and the migration of reconstruction implants have generated the need and importance of continuing to study new techniques, including with the help of technology. Virtual planning combined with endoscopic access and 3D models could decrease the number of complications associated with the aforementioned problems.

Objective

the aim of this observational retrospective study is to show the authors' experience of 19 cases in different orbital fractures using endoscopic support, virtual planning and intraoperative surgical navigation as great alternative in orbital reconstruction.

Methods

The sample consisted of 19 subjects operated on between January 2017 and June 2020 at the Hospital Universitario de la Samaritana, Bogota, Colombia. These subjects had to meet the following inclusion criteria, pure fracture of some orbital wall either single or combined, surgeries performed using a combination of endoscopic support, virtual planning with the reconstruction of mirror image, 3D model printing and intraoperative virtual navigation. The subjects excluded from the study were those who suffered some basic systemic pathology that affected healing or who had a follow-up period of fewer than 6 months

Results

The overall patients show the groups, Female 11% (n: 2), male 89% (17), the age range was 21 to 55 years old. In this study, the main trauma mechanism was, violence 48% (n: 9), followed by Traffic accidents 37% (n: 7) and fall down 15% (n: 3). Hence, the orbital walls involved were: floor and lateral wall 52% (n: 10), orbital floor 21% (n: 4), orbital floor and medial wall 21% (n: 4) and medial wall 6% (n: 1). Diplopia was present in 68% (n: 13) of the patients. The treatment was approached in 53% (n: 10) of the cases with endoscopic support and the others 47% (n: 9) of cases were made under endoscopic support plus virtual planning and 3D printing model and intraoperative surgical navigation. In addition, endoscopic support solved the diplopia in 60% of the cases and endoscopic support plus virtual planning and 3D printing model and intraoperative surgical navigation solved the diplopia in 89% of the cases. Complications represent a 26% (n: 5) of total, ectropion 20%(n:4) Epiphora 6% (n:1).

Conclusion

In our results, the resolution of diplopia was achieved in 60% of cases with endoscopic support. In severe cases, adding virtual planning with a mirror image, 3D printing model and intraoperative surgical navigation improved our results by reaching 89% of the resolution of diplopia with a 6-month follow-up post-operative, which means that in our study virtual planning, endoscopy and intraoperative surgical navigation improve clinical outcomes by 29%.

CRITICAL SIZE BONE DEFECT IN THE PROXIMAL TIBIA, APPROACH WITH A CUSTOM TITANIUM SCAFFOLD USING THREE-DIMENSIONAL IMPRESSION: CASE REPORT

J. J. Pérez C1 , F. Saboyá Y2, W. R. Bayona P, R. E. Olivieri Ch

Abstract

Critically sized bone defects are defined as those that will not heal spontaneously unless there is a secondary intervention. They represent a challenge for the surgeon, health systems and patients. We present the case of a male patient who, after suffering a complex fracture of the right proximal tibia, shows signs of infection for which he required extensive debridement, resulting in a critical size bone defect which is treated using a porous titanium scaffold manufactured to the measurement by 3D printing taking advantage of the Masquelet induced membrane technique.

INTRODUCTION

Pathological and traumatic processes that result in complex bone defects represent a real challenge for current orthopedic surgery as they involve a high morbidity, generate high costs for health systems and lead to a increase in years of life lost due to disability. There is currently no standardized treatment and, in general, the different surgical techniques available are based on the principles of the diamond concept (1), that is; its execution must meet osteogenic, osteoinductive properties, a matrix osteoconductive, an optimal mechanical environment and having a vascularization adequate that allow a correct bone consolidation. From the development of three-dimensional printing technologies and engineering of tissues has been explored the use of biomodels, made to measure as a viable therapeutic alternative in certain clinical contexts. We present the case of a patient with a critical size bone defect in the proximal tibia operated on using Masquelet's induced membrane technique in conjunction with a custom-made porous titanium implant, manufactured by 3D printing in a IV level care center in the city of Cali, Colombia.

CLINICAL CASE

This is a 46-year-old patient, with no pathological, toxic or relevant traumatic; who suffers high energy trauma from a car accident traffic as a motorcycle driver, which conditions a closed fracture at the level of the right proximal tibia (Classification AO: 41C3.1) associated with trauma of soft tissues Tscherne grade 2 (Fig. 1 a, b, c) which required initial management with external fixative as a damage control protocol and two weeks later; when the integumentary component allowed it, he was taken to osteosynthesis final application of calcium sulfate and a fixation construct with two proximal tibia plates. Approximately eight weeks later, the patient consults again with emergency department describing edema, heat and erythema of the perilesional area of the right leg. An infectious process was suspected for which it began antibiotic coverage and was taken to surgical exploration finding signs of deep bacterial infection with biologically unviable bone tissue; in view of which is decided to remove the osteosynthesis material and carry out debridement extensive, resulting in a cavity bone defect of the tibia proximal. Taking this situation into account, cement spacer was applied with antibiotic (four vials of Vancomycin) as the first stage of the technique of Masquelet (Fig 1. d, e, f) Seeking to cover the existing critical bone defect, it was decided to use an implant porous titanium scaffold type, custom made, scan designed computed high resolution and manufactured by three-dimensional printing (Fig. 2a) Approximately twenty weeks later, prior pre-surgical planning in virtual surgery and intraoperative trial with 3D polyethylene replica; the patient is taken to second half of the Masquelet technique by definitive application within the induced membrane of the implant described, which was favored with biological augmentation by autograft (rhyming / irrigation / aspiration system) and allografts (morphogenetic protein, demineralized bone matrix and chips of fluffy). Finally, the construct is fixed using two plates, equally made to measure, which allow the passage of screws through the scaffold in the medial and lateral plane (Fig. 2 b, c, d). Following this, early rehabilitation is performed, the patient achieves gait with support in the immediate postsurgical without complications. Six months later, continues in clinical follow-up where it shows adequate functional results and Satisfactory radiological signs of biological integration between the bone graft and the porous titanium implant (Fig. 3).

DISCUSSION

Although there is no established and consensual definition, it is understood by default critical size bone that will not be able to heal spontaneously without there is an intervention aimed at it. Some authors have used a loss greater than 50% of the cortical circumference and a fracture gap of more than 1 centimeter in length as objective parameters to define the critical bone defect in the tibia (2). The causes of critical bone defects are varied, including find avulsion injuries involving loss of the periosteum, fractures of high energy, debridement due to infection, tumor resection, among others (3). As defined by its definition, the approach to critical size bone defects is not is standardized, in general it will depend on the bone segment to be treated, the soft tissue status, available resources, and surgeon's experience. A wide range of therapeutic possibilities are described in the literature, such as such as auto and allograft bone grafts, vascularized bone grafts and not vascularized, bone distraction osteogenesis, membrane technique induced and in recent years the management through implants of biomaterials and mega prostheses (3) (4) In large critical bone defects of the lower limbs the membrane technique Induced Masquelet (5) has been shown to be an effective method. It is a two-stage intervention based on the principles of the diamond concept. As we want to demonstrate in this case, as the evolution of this technique, provides the possibility of using the induced membrane as an envelope to tissue engineering grafts (6); which are equally consistent with the principles of the aforementioned diamond concept, and offer the benefit of limiting amount of autologous graft required, reducing morbidity in the area donor (7) As part of this tissue engineering, in search of repairing bone defects large size, with the advancement in 3D printing technology recently have scaffold-type models have been developed (from English: Scaffold); made in various biomaterials, structured with pores inside whose distribution and Sizes fulfill a task in osseointegration (8). These scaffolds have the ability to be adequate to the particular configuration of the defect, regardless of the anatomical complexity of it. Among them, the titanium base has been used in preclinical and clinical studies, mostly for craniofacial defects,

CRITICAL SIZE BONE DEFECT IN THE PROXIMAL TIBIA, APPROACH WITH A CUSTOM TITANIUM SCAFFOLD USING THREE-DIMENSIONAL IMPRESSION: CASE REPORT

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DISCUSSION

Al These scaffolds have the ability to be adequate to the particular configuration of the defect, regardless of the anatomical complexity of it. Among them, the titanium base has been used in preclinical and clinical studies, mostly for craniofacial defects, for its advantages such as high biocompatibility, strength / weight ratio, low modulus elastic and high resistance to corrosion (9). Although its potential is limited by the inability to biodegrade and its high cost. Additionally, orthopedic surgery benefits from the implementation and use of biomodels manufactured by 3D printing, which allows the study of fractures and their approximation to them, improving pre-surgical planning, which has been shown to reduce some indicators such as surgical time, intraoperative bleeding, and exposure to fluoroscope (10) In this case, our patient had a cavitary bone defect located in the right proximal tibia, as a result of excision of devitalized tissue by infection, which covered about 65% of the circumference of the cortex with a length of about 9 cm, so it was decided then to tackle it using the Masquelet technique and, take advantage of the induced membrane as biological coating for a scaffold-type porous titanium implant; to whom I know favored the properties of osteoinduction and osteoconduction through the biological augmentation, and that provided mechanical support allowing to save the defect and obtain favorable results in the functionality and quality of life of the patient. It is necessary to comment that the difficulty to develop and print the implantation in our environment led to an increase in the interval between the first and second half of the Masquelet technique, which made a difference with the current surgical indications for this technique. This type of intervention opens a promising horizon as an alternative therapeutics in the field of reconstructive bone surgery; specially for Bone defects of critical size, although further studies and clinical experiences that allow its implementation and use to be extended to the future.

LEVEL OF EVIDENCE

Level of evidence IV.

ETHICAL RESPONSIBILITIES

Protection of people and animals. The authors declare that for this research no experiments have been performed on humans or animals. Confidentiality of the data. The authors declare that they have followed the protocols of your work center on the publication of patient data. Right to privacy and informed consent. The authors declare that This article does not appear identification data of the patient and they have the Informed consent to use the data from your medical record.

CONFLICT OF INTERESTS

None to declare

CRITICAL SIZE BONE DEFECT IN THE PROXIMAL TIBIA, APPROACH WITH A CUSTOM TITANIUM SCAFFOLD USING THREE-DIMENSIONAL IMPRESSION: CASE REPORT

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Figure 1. (a-b) Initial radiographs of the right leg in which a multifragmentary fracture of the proximal third of the tibia with compromise of the articular veneers and significant displacement of the fragments. (c) State of soft tissues at the time of the initial consultation. (d) Fluoroscopic view of the bone defect resulting from surgical debridement for osteomyelitis. (e-f) Postoperative X-ray of the first stage of Masquelet, the measurements are added of the bone defect.

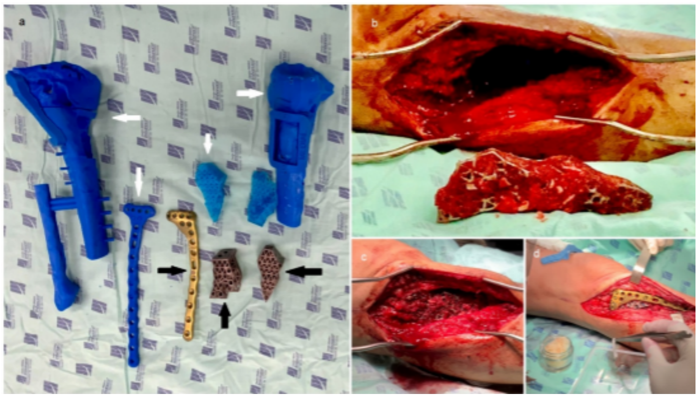

Figure 2. (a) Preoperative readiness, white arrows indicate biomodels Preliminary for intrasurgical testing made of polymer. Observe yourself Also with black arrows the definitive scaffold and fixation plate. (b) Image intraoperative bone defect (c) Titanium scaffold with RIA autologous filling (d) Definitive insertion of the scaffold in the bone defect. (f) Fixation of the construct using a customized proximal tibia plate and application of biological augmentation by allograft.

Figure 3. (a, b) Control and follow-up radiographs six months after postoperative in which adequate positioning of the material of the osteosynthesis and signs of osseointegration (c, d) Arches of mobility in flexion and right knee extension during clinical follow-up at six months postoperative.

PATIENT-SPECIFIC IMPLANTS FOR MAXILLOFACIAL DEFECTS: CHALLENGES AND SOLUTION

Dr. Nasser Alasseri

Background

Reconstructing maxillofacial defects is quite challenging for most surgeons due to the region's complex anatomy and cosmetic and functional effects on patients. The use of pre-made alloplastic implants and autogenous grafts is often associated with resorption, infection, and displacement. Recent technological advances have led to the use of custom computer-designed patient-specific implants (PSIs) in reconstructive surgery. This study describes our experience with PSI, details the complications we faced, how to overcome them, and finally, evaluates patient satisfaction.

Case presentation

Six patients underwent reconstruction of various maxillofacial defects arising due to different etiologies using PSI. A combined total of 10 implants was used. PEEK was used to fabricate 8, while titanium was used to fabricate 2. No complications were seen in any patient both immediately post-op and in subsequent follow-ups. All patients reported a high level of satisfaction with the final result both functionally and cosmetically.

ConclusionThe use of computer-designed PSI enables a more accurate reconstruction of maxillofacial defects, eliminating the usual complications seen in preformed implants and resulting in higher patient satisfaction. Its main drawback is its high cost.

Techfit Digital Surgery Publications

Highly Complex Maxillofacial Reconstruction for Oncologic Patient with Customized Implant

Dr.Gustavo Adolfo Cuello [1], Daniel Restrepo [2], Alejandro Serna [2], Mauricio Toro R [2], Tatiana Rios [2]
[1]Centro Medico Imbanaco, Cali, Colombia
[2]Industrias Medicas Sampedro, Medellin, Colombia

ABSTRACT

The use of 3D technology for planning the reconstructive surgery and producing custom implants and surgical guides has gained importance as a tool that provides surgeons with the ability to accurately plan each patient's treatment, reducing surgical time and its associated risks.

This work describes the development of a reconstruction solution for a female patient, with multiple maxillofacial injuries caused by ossifying fibroma, requiring reconstruction of the eye socket, malar and right hemimaxilla. The surgical planning included the oral rehabilitation, the design of the surgical guides and the anatomic implants. Then mechanical strength of these implants was analyzed by finite element analysis (FEA) considering occlusion loads which can occur after oral rehabilitation.

MATERIALS AND METHODS

Case Analysis

Female Patient, 45 years old.

Diagnostic: Ossifying fibroma and polypoid chronic sinusitis with injuries of right hemimaxilla, right exophthalmos with epiphora, nostril and choana damage compromising the right sphenoid sinus.

Implant Design

The future oral rehabilitation was considered and the left hemimaxilla was designed according to the natural angle of the occlusal plane, leaving the interface prepared for subsequent attachment of dental implants.

The walls and floor of the right eye socket were manufactured in PEEK and it was assembled to the main structure of the anatomic implant manufactured in titanium, the difference on materials was considered in order to not compromise the main structure of the implant in the case of any complication with complete tumor resection.

Figure 1: Soft tissue and bony Injuries

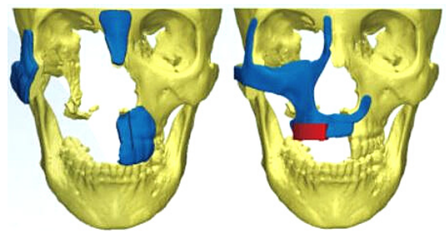

Figure 2: Osteotomies planning and design of the surgical guides and implants

FINITE ELEMENT ANALYSIS (FEA) OF THE IMPLANT

Attachment points in the implant are thin and the fact that the structure will be loaded once the oral rehabilitation is completed, meant that a Finite Element Analysis was required in order to determine the safety and stability of the maxillofacial recontruction.

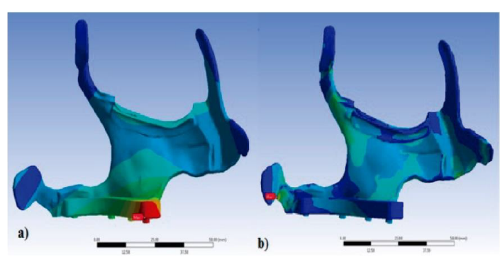

Figure 3: a) Maximum displacement point. b) Maximum strength points

RESULTS

The surgery ws performed using a Weber Ferguson back surgical approach for both the implant and the implant fixation. The implants perfectly matched the patient's anatomical structures and the fixation was performed as planned.

Figure 4: Implant Accommodation

CONCLUSION

The 3D technology represents an important opportunity for patients with significant craniomaxillofacial defects to restore functionality and aesthetic appearance. Combining 3D technoogy with finite element analysis is a helpful tool in order to achieve the most fitted design to the specific patient needs.

Techfit Digital Surgery Publications

Bone Flap Reconstruction of Mandibular Defects after Oncologic Resection in the Institute of Cancer of Las Americas Clinic

*Arango, C. DDS, *Zuniga, S. MD, *Lopera, J. MD, *Arango, A. DDS, *Taissoun, Z. MD, *Giraido, L. MD, *Rojas, A. MD, **Cardona, A. PhD, **Toro, M, Engineer Msc., **Medina, A, Biomedical Engineer.

* Instituto de Cancerologia Clinica Las Americas.

**Industraias Medicas Samedro . Medellin, Colombia

ABSTRACT

Mandible reconstruction remains one of the challenges faced by head and neck and reconstructive surgeons for cancer. Loss of mandibular continuity after tumor resection compromises oral function and esthetic appearance impairing quality of life. Microvascular grafts have become the gold standard of treatment for management of mandibular defects post resection. We present a descriptive study to show the experience at Instituto de Cancerología Clínica (IDC) Las Américas, Medellin, Colombia, and the outcome in 59 cases requiring mandibular reconstruction with free fibula flap after large surgical excision for tumors.

MATERIALS AND METHODS

We reviewed the medical records of our Head and Neck Department between November 2011 and July 2016, and gathered data from 59 patients who required reconstruction with microvascular free fibula flap. 12 (20%) patients had preoperative radiation, 22 (37%) history of tobacco use, 19 (32%) hypertension and 7 (11%) diabetes.

Table 1. Etiology of the osseus defect

Diagnosis	Number of patients	% Patients
Squamous cell carcinoma	27	45%
Ameloblastoma	9	16%
Osteoradionecrosis	4	7%
Osteosarcoma	3	5%
Ossiffying Fibroma	3	5%
Myxoma	2	3%
Other	11	19%
Total	59	100%

Surgical planning protocol included a CT scan of the patient's face in full occlusion. MIMICS® is used to generate a 3D reconstruction of the bone structure, while the mandible is segmented from the rest of the cranium and a Fused Deposition Modelling (FDM) machine creates ABS (Acrylonitrile butadiene styrene) prototypes in order to obtain a plastic model of the patient's defect. These models are used to conduct a personalized surgical plan.

Figure 1: 3D full occlusion CT reconstruction anatomical models for surgical planning

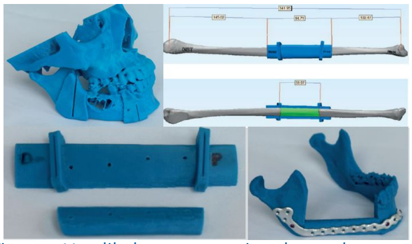

Figure 2: Mandibular reconstruction plate and ostetomy custom cutting guides.

The next step is to design the prosthesis and osteotomy guides. The plate is manufactured with commercially pure grade 4 Titanium for better osseointegration.

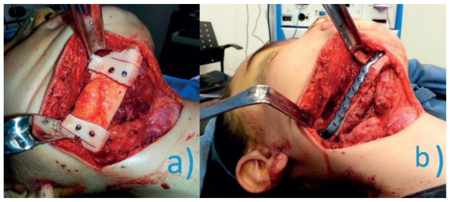

Figure 3. a) Tumor resection with custom cutting guides, b) Reconstruction with bone flap and titanium plate.

Surgical simulation of all the components of the plate and resection guides is performed on the 3D printed models to complete intervention planning

RESULTS

The study group included 59 patients, 28 (47%) men and 31 (53%) women. The average age at the time of the operation was 51 years (11- 92). 39 (66%) had vascularized osteocutaneous fibula free flap reconstruction
and 20 (34%) an osseous vascularized fibula flap only The average operation time was 420 minutes. 51 (86.4%) flaps were successful and the postoperative courses were uneventful. Complications occurred in 22 patients (37%). Free flap failure occurred in 8 (13%) of the 59 patients, 7 (88%) of them were heavy smokers and 5 (63%) had prior radiation therapy.

DISCUSSION

The head and neck surgery team at the IDC Las Américas have used this technique since 2011. All materials are made in Colombia. The reconstruction of mandibular defects following surgical resection for benign and malignant oral cavity tumors and others with fibula free flaps has shown to be a reliable technique with good short and long-term prognosis. The current 3D virtual technology and personalized prototypes have allowed for successful reconstructions. Risk factors for failure were tobacco use and prior radiation therapy.

CONCLUSIONS

Current mandibular reconstruction strategies that combine interdisciplinary surgical planning and 3D technology improve functional and cosmetic results. Quality of life without risking oncologic outcomes can be achieved.

REFERENCES

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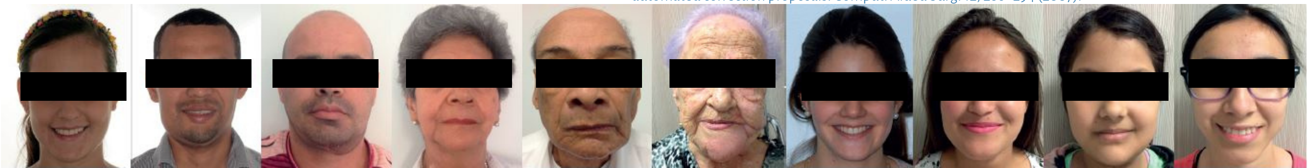

Mandibular Reconstruction Using Free Microvascularized Fibula Flap and Virtual Surgical Planning in Resection of Desmoplastic Fibroma of the Jaw: Literature Review and a Rare Case Report

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ABSTRACT

Maxillary reconstruction remains one of the challenges faced by the reconstructive surgeon. The maxilla is a multifunctional structure with complex architecture and mechanics, Responsible for the basic oral functions such as normal mastication, speech, phonation and swallowing, and cosmetically defines the middle third of the face. Loss of maxillary continuity compromises oral function and aesthetic appearance impairing quality of life.

BACKGROUND

Central giant cell tumors are benign but aggressively destructive osteolytic lesions. It is histopathologically and behaviorally identical to the benign giant cell tumor of long bones. Clinically, it presents as a painless expansion that may have a short ascendancy. The average age of occurrence is between 5 and 15 years, but it can be developed in 20s or 30s, with female predominance. Mandible is more often affected than maxilla. Radiographic findings such as multilocular, radiolucent lesion with thins corticales (soap bubble), displace teeth are describe. Nonsurgical treatment and surgical treatment are found in the literature.

MATERIALS AND METHODS

A 45-year-old Caucasian female with the main concern of slowly growing painless swelling in the right maxilla since 1 year. Clinical examination revealed expansion of the maxilla with obliteration of the right buccal vestibule, hard palate and the floor of the right orbit. The swelling was hard and nontender on palpation.

The main concern was her asymmetry. An incisional biopsy reveled central giant cell tumor..

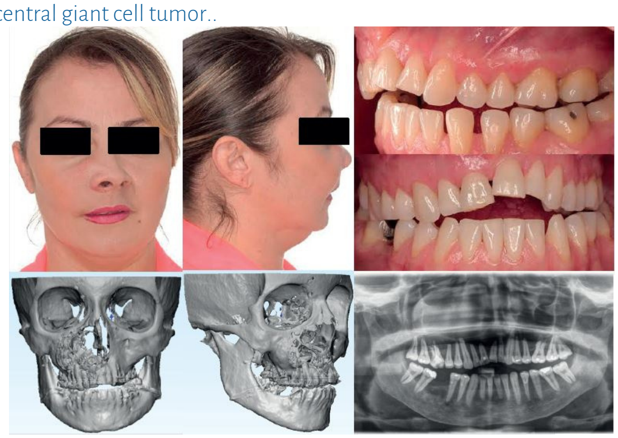

Figure 1: 3D full occlusion CT reconstruction anatomical models for surgical planning.

Then, a hemimaxillectomy was performed for resection with a maxillary reconstruction using a free microvascularized fibula flap with a plate and custom made titanium mesh for the orbital floor, using virtual surgical planning with cutting guides.

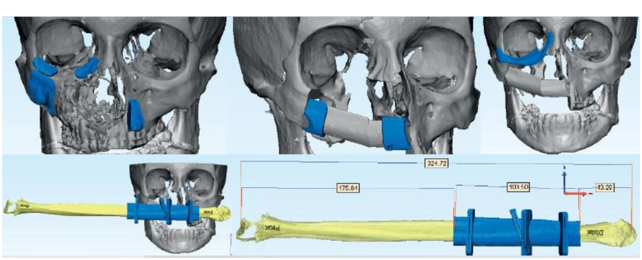

Figure 2: Ostetomy custom cutting guides

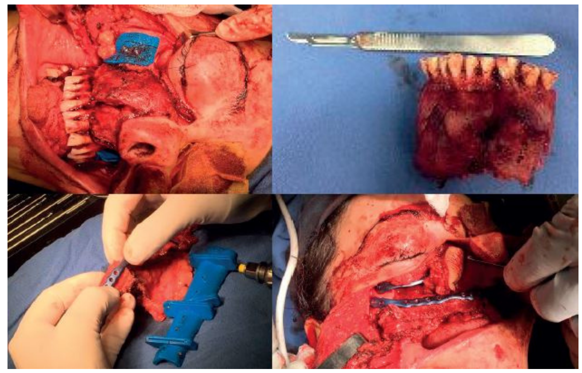

Figure 3. a) Tumor resection with custom cutting guides, b) Reconstruction with bone fap and titanium plate.

RESULTS

The follow up has been made for more than one year with excellent esthetic result. A removable dental prosthetic was made after three months. No recurrence has been found. CT scan was taken for assure good contact between the segments and symmetry.

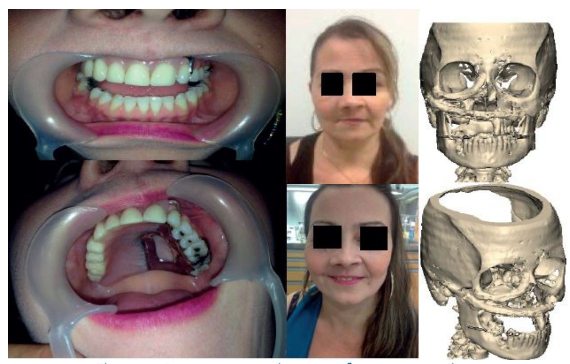

Figure 4. Post operatory images after one year since surgery.

CONCLUSIONS

It is possible to understand, as described, why maxillary reconstruction has been considered a challenge. Advancements in reconstructive techniques have given surgeons greater ability to clear malignancies and thus to improve the chances of survival. Functional and aesthetic outcomes also improve the patients' quality of life. Indeed, microsurgical free flap is today the standard of care for patients with large, composite defects after tumor resections. The new era leading to mandibular reconstruction strategies combine surgical procedures with digital planning and CAD-CAM technology, gathering engineering and medical competences.

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Treatment of Maxillary Defects Using Custom-Made Implants with Vascularized Fibular Flap

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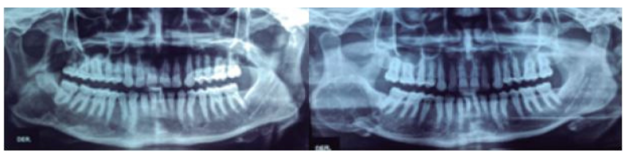
Craniofacial tumor resection is one of the procedures in maxillofacial surgery that demand some skills for achieve stability, function and esthetics. Taylor et al first described the microsurgical fibula flap in 1975. The fibula provides approximately 25 cm of bone, which is sufficient to reconstruct any mandibular defect, both a bone flap and an osteocutaneous flap can be obtained.

BACKGROUND

3Desmoplastic fibroma is a very rare local, benign, and aggressive tumor that occurs before the age of 40, with male predominance. The mandible is the principle site of occurrence, followed by the femur, tibia and pelvis. The most important differential diagnosis is the low-grade fibrosarcoma. Curettage does not eradicate all tumor tissue; therefore, an enbloc resection of the lesion with wide margins is suggested in the literature. We believe this case represents one of the few cases reported in the literature with the subsequent maxillofacial reconstruction.

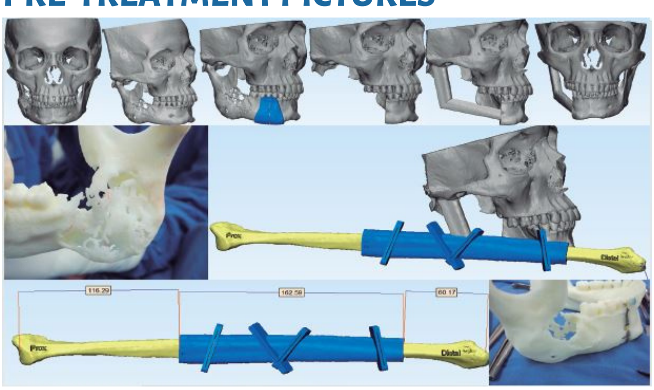
INITIAL CLINICAL PICTURES



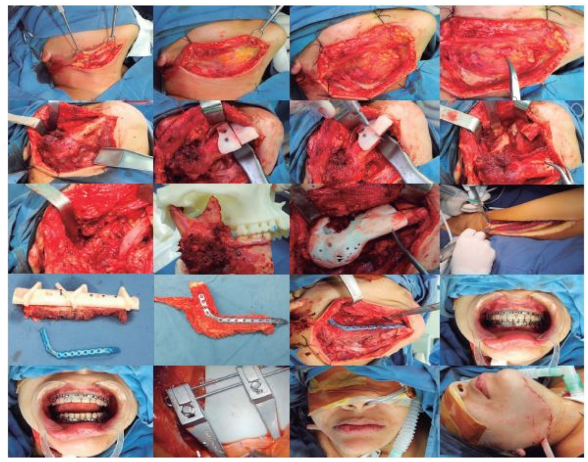
MATERIALS AND METHODS

This is a female, Caucasian, 40 years old, with the chief complaint of slowly growing painless swelling in the right lower back tooth region since 2 years. The swelling was hard and nontender on palpation. Clinical extra-oral examination revealed expansion of the rigth inferior border of the mandible and intra- oral examination revealed a solitary bony hard swelling measuring about 4.0 cm × 5.0 cm in size with obliteration of the left buccal vestibule in relationto 47 and 48. An incisional biopsy revealed a desmoplastic fibroma, then the patient was taken to hemimandibulectomy procedure for resection of the tumor with the subsequent mandibular reconstruction using free microvascularized fibula flap using previous 3D virtual surgical planning for design a custom made plate with its cutting guides

PRE-TREATMENT PICTURES



SURGICAL TREATMENT PICTURES



FOLLOW-UP: POS RX

RESULTS

The patient has been evaluated for 3 times since her last intervention, the occlusion was the same planned before the surgery, the esthetic was measured by concern of the patient who referred she was satisfied with the results. CT scan was taken for assure good contact between the native and the bone graft, also it was made a ultrasonography for analyze the good irrigation of the microvascularized fibula The microvascularized fibula flap was assessed for devitalized zones, the facial symmetry was optimum, also the occlusion is stable since the intervention until nowadays

CONCLUSIONS

It is quite probable that the desmoplastic fibroma does occur with a much higher frequency than the present case report seems to indicate. The Free microvascularized fibula flap shows excellent stability when it is use with 3D planning and surgical guides.

The Quest for Accurate Patient-Specific Guides for Distal Radius Osteotomy Surgery

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INTRODUCTION

The Distal Radius Osteotomy is a very common procedure for correcting malunions. In order to improve correction accuracy, patient specific surgical guides were manufactured using 3D printing and 3D surgical planning (Figure 1). The accuracy of patient-specific guides was evaluated by a comparison between 3D planned correction, correction., correction made using the patient-specific guide and the correction using the traditional technique.

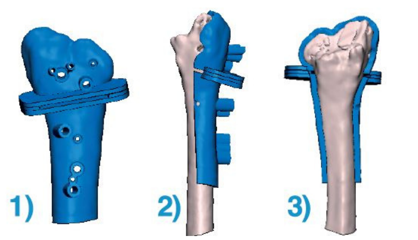

Figure 1: Patient-specific cutting guide. 1) Front view patient-specific cutting guide; 2) Lateral view, patient-specific guide positioned on bone; 3) posterior view, patient-specific guide positioned on bone.

MATERIALS AND METHODS

CT images of both upper limbs of a female patient, with a malunion in her left radis, were obtained and 3D recontructed with Minics Medical software. The 3D model was used for planning the correction osteotomy and posteriorly a patient-specific guide was created using 3-matic Medical .

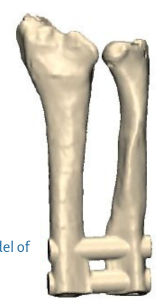

Figure 2: Polyurethane model of the wrist with malunion

3D printing in ABS was used to obtain a physical model of the malunited distal radius and ulna. This was then used as a mold for 24 polyurethane bones as shown in the Figure 2. A protocol for evaluating the accuracy of the guides was designed, where the 24 polyurethane models were corrected, 12 of them using patient-specific guide and the remaining 12 using the traditional technique (Figure 3). After correcting, all samples were 3D scanned for virtual measurements. For a significant comparison three anatomic values were measured on each sample and comapred to the planned correction, those were: radial angle, radial shortening, radial displacement (Figure 4).

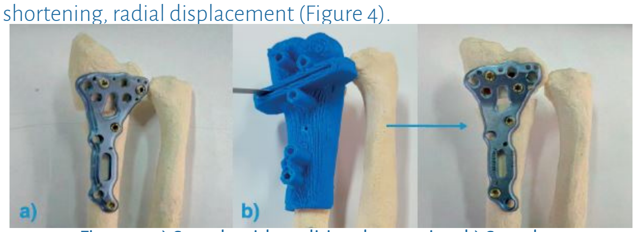

Figure 3: a) Sample with traditional correction. b) Samples with correction using the patient-specific guides

In order to reduce results bias, samples were measured by two blind observers. The resulting measurements were statistically analyzed by averages and standard deviations, which were compared between the planned correction and the correction obtained by both traditional and patient-specific guide techniques. (Figure 5)

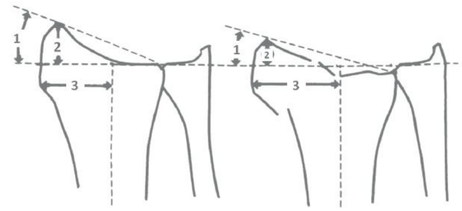

Figure 4: AP view, 1) Radial angle, 2) Radial shortening, 3) Radial displacement. Taken from De la Cruz Fernandez, M.J.S. Fracturas distales de radio: clasificacion, tratamiento conservador. Rev. Esp. Cir. Orthop. Traumatol. 46, 141-154 (2008).

RESULTS

Table 1. Measurements for traditional and patient-specific guide techniques.

	Radial Angle		Radial Shortening		Radial Displacement	
Technique	Guide	Traditional	Guide	Traditional	Guide	Traditional
Average	29,52	38,36	11,80	13,64	12,69	11,72
Standard deviation	3,16	4,62	1,33	1,76	1,049	1,56
Planned Correction	29,48		11,91		12,8	
Deviation from Planned	0,04	8,88	0,11	1,73	0,11	1,08
Percentage of planned	100%	70%	99%	85%	99%	92%

Table 1 shows the final results for each technique, compared to the planned correction. The most representative values are the "Precentage of Planned", the highest accuracy was found for the radial angle with the guided method. The highest variability across all dimensions studied was the radial angle. Similar accuracies were observed for the other dimensions, where the highest accuracy was obtained with the guided technique.

Figure 5: Front view from the comparison between planned correction, traditional technique and patient-specific guide use.

CONCLUSIONS

A good anatomic correction is critical in obtaining good patient outcomes for distal radius malunions, The use of 3D planning, and comparison to mirror of the healthy contralateral limb is a very good way to obtain the patient's basic dimensions. Measuring these dimensions before and after a correction is a good means of assessing the degree of correction obtained. The higher standard deviations found using the standard porcedure suggests that the use of the patient-specific guides allows for more repeatable results. The higher "Percentage of Planned" values founs in the use of the guides suggest a more accurate surgery. An in vivo study to corroborate the findings is recommended to show that the increased precision and accuracy will translate to shorter surgical times, faster learning curves and better patient outcomes.