2024-2025

THÈSE

pour le

DIPLÔME D'ÉTAT DE DOCTEUR EN MÉDECINE

Qualification en Chirurgie Maxillo-faciale et stomatologie

BONE GRAFT IN BILATERAL MANDIBULAR SAGITTAL SPLIT OSTEOTOMY: THE CURRENT STATE OF PRACTICE IN FRANCE

Etat des lieux sur les pratiques en France de la greffe dans le foyer d'ostéotomie lors des chirurgies d'avancée mandibulaire

BILLON Charlotte

Née le 10/12/1997 à Les Sables d'Olonne (85), FRANCE

Sous la direction de M. le Professeur KUN DARBOIS Jean-Daniel

Membres du jury

Monsieur le Professeur LACCOURREYE Laurent	Président
Monsieur le Professeur KUN DARBOIS Jean-Daniel	Directeur
Monsieur le Professeur LAURE Boris	Membre
Monsieur le Docteur RONY Louis	Membre
Monsieur le Docteur DECHAUFOUR Pierre	Membre

Soutenue publiquement le :
13/06/2025

FACULTÉ DE SANTÉ
UNIVERSITÉ D'ANGERS

ENGAGEMENT DE NON PLAGIAT

Je, soussignée BILLON Charlotte
déclare être pleinement consciente que le plagiat de documents ou d'une partie d'un document publiée sur toutes formes de support, y compris l'internet, constitue une violation des droits d'auteur ainsi qu'une fraude caractérisée.
En conséquence, je m'engage à citer toutes les sources que j'ai utilisées pour écrire ce rapport ou mémoire.

signé par l'étudiante le **08**/**04**/**2025**

SERMENT D'HIPPOCRATE

« Au moment d'être admise à exercer la médecine, je promets et je jure d'être fidèle aux lois de l'honneur et de la probité. Mon premier souci sera de rétablir, de préserver ou de promouvoir la santé dans tous ses éléments, physiques et mentaux, individuels et sociaux. Je respecterai toutes les personnes, leur autonomie et leur volonté, sans aucune discrimination selon leur état ou leurs convictions. J'interviendrai pour les protéger si elles sont affaiblies, vulnérables ou menacées dans leur intégrité ou leur dignité. Même sous la contrainte, je ne ferai pas usage de mes connaissances contre les lois de l'humanité. J'informerai les patients des décisions envisagées, de leurs raisons et de leurs conséquences. Je ne tromperai jamais leur confiance et n'exploiterai pas le pouvoir hérité des circonstances pour forcer les consciences. Je donnerai mes soins à l'indigent et à quiconque me les demandera. Je ne me laisserai pas influencer par la soif du gain ou la recherche de la gloire.

Admise dans l'intimité des personnes, je tairai les secrets qui me seront confiés. Reçue à l'intérieur des maisons, je respecterai les secrets des foyers et ma conduite ne servira pas à corrompre les mœurs. Je ferai tout pour soulager les souffrances. Je ne prolongerai pas abusivement les agonies. Je ne provoquerai jamais la mort délibérément.

Je préserverai l'indépendance nécessaire à l'accomplissement de ma mission. Je n'entreprendrai rien qui dépasse mes compétences. Je les entretiendrai et les perfectionnerai pour assurer au mieux les services qui me seront demandés.

J'apporterai mon aide à mes confrères ainsi qu'à leurs familles dans l'adversité. Que les hommes et mes confrères m'accordent leur estime si je suis fidèle à mes promesses ; que je sois déshonorée et méprisée si j'y manque ».

LISTE DES ENSEIGNANTS DE LA FACULTÉ DE SANTÉ D'ANGERS

Doyen de la Faculté : Pr Cédric ANNWEILER
Vice-Doyen de la Faculté et directeur du département de pharmacie : Pr Sébastien FAURE
Directeur du département de médecine : Pr Vincent DUBEE

PROFESSEURS DES UNIVERSITÉS

ABRAHAM Pierre	PHYSIOLOGIE	Médecine
ANGOULVANT Cécile	MEDECINE GENERALE	Médecine
ANNWEILER Cédric	GERIATRIE ET BIOLOGIE DU VIEILLISSEMENT	Médecine
ASFAR Pierre	REANIMATION	Médecine
AUBE Christophe	RADIOLOGIE ET IMAGERIE MEDICALE	Médecine
AUGUSTO Jean-François	NEPHROLOGIE	Médecine
BAUFRETON Christophe	CHIRURGIE THORACIQUE ET CARDIOVASCULAIRE	Médecine
BELLANGER William	MEDECINE GENERALE	Médecine
BELONCLE François	REANIMATION	Médecine
BIERE Loïc	CARDIOLOGIE	Médecine
BIGOT Pierre	UROLOGIE	Médecine
BONNEAU Dominique	GENETIQUE	Médecine
BOUCHARA Jean-Philippe	PARASITOLOGIE ET MYCOLOGIE	Médecine
BOUET Pierre-Emmanuel	GYNECOLOGIE-OBSTETRIQUE	Médecine
BOURSIER Jérôme	GASTROENTEROLOGIE ; HEPATOLOGIE	Médecine
BOUVARD Béatrice	RHUMATOLOGIE	Médecine
BRIET Marie	PHARMACOLOGIE	Médecine
CAMPONE Mario	CANCEROLOGIE ; RADIOTHERAPIE	Médecine
CAROLI-BOSC François-Xavier	GASTROENTEROLOGIE ; HEPATOLOGIE	Médecine
CASSEREAU Julien	NEUROLOGIE	Médecine
CLERE Nicolas	PHARMACOLOGIE / PHYSIOLOGIE	Pharmacie
COLIN Estelle	GENETIQUE	Médecine
CONNAN Laurent	MEDECINE GENERALE	Médecine
COPIN Marie-Christine	ANATOMIE ET CYTOLOGIE PATHOLOGIQUES	Médecine
COUTANT Régis	PEDIATRIE	Médecine
CUSTAUD Marc-Antoine	PHYSIOLOGIE	Médecine
CRAUSTE-MANCIET Sylvie	PHARMACOTECHNIE HOSPITALIERE	Pharmacie
DE CASABIANCA Catherine	MEDECINE GENERALE	Médecine
DERBRE Séverine	PHARMACOGNOSIE	Pharmacie
DESCAMPS Philippe	GYNECOLOGIE-OBSTETRIQUE	Médecine
D'ESCATHA Alexis	MEDECINE ET SANTE AU TRAVAIL	Médecine

DINOMAIS Mickaël	MEDECINE PHYSIQUE ET DE READAPTATION	Médecine
DUBEE Vincent	MALADIES INFECTIEUSES ET TROPICALES	Médecine
DUCANCELLE Alexandra	BACTERIOLOGIE-VIROLOGIE ; HYGIENE HOSPITALIERE	Médecine
DUVERGER Philippe	PEDOPSYCHIATRIE	Médecine
EVEILLARD Matthieu	BACTERIOLOGIE-VIROLOGIE	Pharmacie
FAURE Sébastien	PHARMACOLOGIE PHYSIOLOGIE	Pharmacie
FOURNIER Henri-Dominique	ANATOMIE	Médecine
FOUQUET Olivier	CHIRURGIE THORACIQUE ET CARDIOVASCULAIRE	Médecine
FURBER Alain	CARDIOLOGIE	Médecine
GAGNADOUX Frédéric	PNEUMOLOGIE	Médecine
GOHIER Bénédicte	PSYCHIATRIE D'ADULTES	Médecine
GUARDIOLA Philippe	HEMATOLOGIE ; TRANSFUSION	Médecine
GUILET David	CHIMIE ANALYTIQUE	Pharmacie
HUNAULT-BERGER Mathilde	HEMATOLOGIE ; TRANSFUSION	Médecine
JEANNIN Pascale	IMMUNOLOGIE	Médecine
KAZOUR François	PSYCHIATRIE	Médecine
KEMPF Marie	BACTERIOLOGIE-VIROLOGIE ; HYGIENE HOSPITALIERE	Médecine
KUN-DARBOIS Daniel	CHIRURGIE MAXILLO-FACIALE ET STOMATOLOGIE	Médecine
LACOEUILLE FRANCK	RADIOPHARMACIE	Pharmacie
LACCOURREYE Laurent	OTO-RHINO-LARYNGOLOGIE	Médecine
LAGARCE Frédéric	BIOPHARMACIE	Pharmacie
LANDREAU Anne	BOTANIQUE/ MYCOLOGIE	Pharmacie
LASOCKI Sigismond	ANESTHESIOLOGIE-REANIMATION	Médecine
LEBDAI Souhil	UROLOGIE	Médecine
LEGENDRE Guillaume	GYNECOLOGIE-OBSTETRIQUE	Médecine
LEGRAND Erick	RHUMATOLOGIE	Médecine
LEMEE Jean-Michel	NEUROCHIRURGIE	Médecine
LERMITE Emilie	CHIRURGIE GENERALE	Médecine
LEROLLE Nicolas	REANIMATION	Médecine
LIBOUBAN Hélène	HISTOLOGIE	Médecine
LUQUE PAZ Damien	HEMATOLOGIE BIOLOGIQUE	Médecine
MARCHAIS Véronique	BACTERIOLOGIE-VIROLOGIE	Pharmacie
MARTIN Ludovic	DERMATO-VENEREOLOGIE	Médecine
MAY-PANLOUP Pascale	BIOLOGIE ET MEDECINE DU DEVELOPPEMENT ET DE LA REPRODUCTION	Médecine
MENEI Philippe	NEUROCHIRURGIE	Médecine
MERCAT Alain	REANIMATION	Médecine
ORVAIN Corentin	HEMATOLOGIE ; TRANSFUSION	Médecine
PAISANT Anita	RADIOLOGIE	Médecine
PAPON Nicolas	PARASITOLOGIE ET MYCOLOGIE MEDICALE	Pharmacie

PASSIRANI Catherine	CHIMIE GENERALE	Pharmacie
PELLIER Isabelle	PEDIATRIE	Médecine
PETIT Audrey	MEDECINE ET SANTE AU TRAVAIL	Médecine
PICQUET Jean	CHIRURGIE VASCULAIRE ; MEDECINE VASCULAIRE	Médecine
PODEVIN Guillaume	CHIRURGIE INFANTILE	Médecine
PROCACCIO Vincent	GENETIQUE	Médecine
PRUNIER Delphine	BIOCHIMIE ET BIOLOGIE MOLECULAIRE	Médecine
PRUNIER Fabrice	CARDIOLOGIE	Médecine
PY Thibaut	MEDECINE GENERALE	Médecine
RAMOND-ROQUIN Aline	MEDECINE GENERALE	Médecine
REYNIER Pascal	BIOCHIMIE ET BIOLOGIE MOLECULAIRE	Médecine
RIOU Jérémie	BIOSTATISTIQUE	Pharmacie
RINEAU Emmanuel	ANESTHESIOLOGIE REANIMATION	Médecine
RIQUIN Elise	PEDOPSYCHIATRIE ; ADDICTOLOGIE	Médecine
RODIEN Patrice	ENDOCRINOLOGIE, DIABETE ET MALADIES METABOLIQUES	Médecine
ROQUELAURE Yves	MEDECINE ET SANTE AU TRAVAIL	Médecine
ROUGE-MAILLART Clotilde	MEDECINE LEGALE ET DROIT DE LA SANTE	Médecine
ROUSSEAU Audrey	ANATOMIE ET CYTOLOGIE PATHOLOGIQUES	Médecine
ROUSSEAU Pascal	CHIRURGIE PLASTIQUE, RECONSTRUCTRICE ET ESTHETIQUE	Médecine
ROUSSELET Marie-Christine	ANATOMIE ET CYTOLOGIE PATHOLOGIQUES	Médecine
ROY Pierre-Marie	MEDECINE D'URGENCE	Médecine
SAULNIER Patrick	BIOPHYSIQUE ET BIOSTATISTIQUES	Pharmacie
SERAPHIN Denis	CHIMIE ORGANIQUE	Pharmacie
SCHMIDT Aline	HEMATOLOGIE ; TRANSFUSION	Médecine
TESSIER-CAZENEUVE Christine	MEDECINE GENERALE	Médecine
TRZEPIZUR Wojciech	PNEUMOLOGIE	Médecine
UGO Valérie	HEMATOLOGIE ; TRANSFUSION	Médecine
URBAN Thierry	PNEUMOLOGIE	Médecine
VAN BOGAERT Patrick	PEDIATRIE	Médecine
VENARA Aurélien	CHIRURGIE VISCERALE ET DIGESTIVE	Médecine
VENIER-JULIENNE Marie-Claire	PHARMACOTECHNIE	Pharmacie
VERNY Christophe	NEUROLOGIE	Médecine
WILLOTEAUX Serge	RADIOLOGIE ET IMAGERIE MEDICALE	Médecine

MAÎTRES DE CONFÉRENCES

AMMI Myriam	CHIRURGIE VASCULAIRE ET THORACIQUE	Médecine
BAGLIN Isabelle	CHIMIE THERAPEUTIQUE	Pharmacie

BASTIAT Guillaume	BIOPHYSIQUE ET BIOSTATISTIQUES	Pharmacie
BEAUVILLAIN Céline	IMMUNOLOGIE	Médecine
BEGUE Cyril	MEDECINE GENERALE	Médecine
BELIZNA Cristina	MEDECINE INTERNE	Médecine
BENOIT Jacqueline	PHARMACOLOGIE	Pharmacie
BERNARD Florian	ANATOMIE	Médecine
BESSAGUET Flavien	PHYSIOLOGIE PHARMACOLOGIE	Pharmacie
BLANCHET Odile	HEMATOLOGIE ; TRANSFUSION	Médecine
BOISARD Séverine	CHIMIE ANALYTIQUE	Pharmacie
BOUCHER Sophie	ORL	Médecine
BRIET Claire	ENDOCRINOLOGIE, DIABETE ET MALADIES METABOLIQUES	Médecine
BRILLAND Benoit	NEPHROLOGIE	Médecine
BRIS Céline	BIOCHIMIE ET BIOLOGIE MOLECULAIRE	Pharmacie
BRUGUIERE Antoine	PHARMACOGNOSIE	Pharmacie
CAPITAIN Olivier	CANCEROLOGIE ; RADIOTHERAPIE	Médecine
CHABRUN Floris	BIOCHIMIE ET BIOLOGIE MOLECULAIRE	Pharmacie
CHAO DE LA BARCA Juan-Manuel	BIOCHIMIE ET BIOLOGIE MOLECULAIRE	Médecine
CHOPIN Matthieu	MEDEECINE GENERALE	
CODRON Philippe	NEUROLOGIE	Médecine
DEMAS Josselin	SCIENCES DE LA READAPTATION	Médecine
DESHAYES Caroline	BACTERIOLOGIE VIROLOGIE	Pharmacie
DOUILLET Delphine	MEDECINE D'URGENCE	Médecine
FERRE Marc	BIOLOGIE MOLECULAIRE	Médecine
FORTRAT Jacques-Olivier	PHYSIOLOGIE	Médecine
GHALI Maria	MEDECINE GENERALE	Médecine
GUELFF Jessica	MEDECINE GENERALE	Médecine
HADJ MAHMOUD Dorra	IMMUNOLOGIE	Pharma
HAMEL Jean-François	BIOSTATISTIQUES, INFORMATIQUE MEDICALE	Médicale
HAMON Cédric	MEDECINE GENERALE	Médecine
HELESBEUX Jean-Jacques	CHIMIE ORGANIQUE	Pharmacie
HERIVAUX Anaïs	BIOTECHNOLOGIE	Pharmacie
HINDRE François	BIOPHYSIQUE	Médecine
JOUSSET-THULLIER Nathalie	MEDECINE LEGALE ET DROIT DE LA SANTE	Médecine
JUDALET-ILLAND Ghislaine	MEDECINE GENERALE	Médecine
KHIATI Salim	BIOCHIMIE ET BIOLOGIE MOLECULAIRE	Médecine
LEFEUVRE Caroline	BACTERIOLOGIE ; VIROLOGIE	Médecine
LEGEAY Samuel	PHARMACOCINETIQUE	Pharmacie
LEPELTIER Elise	CHIMIE GENERALE	Pharmacie
LETOURNEL Franck	BIOLOGIE CELLULAIRE	Médecine
MABILLEAU Guillaume	HISTOLOGIE, EMBRYOLOGIE ET CYTOGENETIQUE	Médecine
MALLET Sabine	CHIMIE ANALYTIQUE	Pharmacie
MAROT Agnès	PARASITOLOGIE ET MYCOLOGIE MEDICALE	Pharmacie
MESLIER Nicole	PHYSIOLOGIE	Médecine
MIOT Charline	IMMUNOLOGIE	Médecine
MOUILLIE Jean-Marc	PHILOSOPHIE	Médecine

NAIL BILLAUD Sandrine	IMMUNOLOGIE	Pharmacie
PAILHORIES Hélène	BACTERIOLOGIE-VIROLOGIE	Médecine
PAPON Xavier	ANATOMIE	Médecine
PASCO-PAPON Anne	RADIOLOGIE ET IMAGERIE MEDICALE	Médecine
PENCHAUD Anne-Laurence	SOCIOLOGIE	Médecine
PIHET Marc	PARASITOLOGIE ET MYCOLOGIE	Médecine
PIRAUX Arthur	OFFICINE	Pharmacie
POIROUX Laurent	SCIENCES INFIRMIERES	Médecine
RONY Louis	CHIRURGIE ORTHOPEDIQUE ET TRAUMATOLOGIQUE	Médecine
ROGER Emilie	PHARMACOTECHNIE	Pharmacie
SAVARY Camille	PHARMACOLOGIE-TOXICOLOGIE	Pharmacie
SCHMITT Françoise	CHIRURGIE INFANTILE	Médecine
SCHINKOWITZ Andréas	PHARMACOGNOSIE	Pharmacie
SPIESSER-ROBELET Laurence	PHARMACIE CLINIQUE ET EDUCATION THERAPEUTIQUE	Pharmacie
TEXIER-LEGENDRE Gaëlle	MEDECINE GENERALE	Médecine
VIAULT Guillaume	CHIMIE ORGANIQUE	Pharmacie

AUTRES ENSEIGNANTS

ATER		
BARAKAT Fatima	CHIMIE ANALYTIQUE	Pharmacie
ATCHADE Constantin	GALENIQUE	Pharmacie
PRCE		
AUTRET Erwan	ANGLAIS	Santé
BARBEROUSSE Michel	INFORMATIQUE	Santé
COYNE Ashley	ANGLAIS	Santé
O'SULLIVAN Kayleigh	ANGLAIS	Santé
RIVEAU Hélène	ANGLAIS	
PAST-MAST		
AUBRUCHET Hélène		
BEAUVAIS Vincent	OFFICINE	Pharmacie
BRAUD Cathie	OFFICINE	Pharmacie
CAVAILLON Pascal	PHARMACIE INDUSTRIELLE	Pharmacie
DILÉ Nathalie	OFFICINE	Pharmacie
GUILLET Anne-Françoise	PHARMACIE DEUST PREPARATEUR	Pharmacie
MOAL Frédéric	PHARMACIE CLINIQUE	Pharmacie
CHAMPAGNE Romain	MEECINE PHYSIQUE ET READAPTATION	Médecine
KAASSIS Mehdi	GASTRO-ENTEROLOGIE	Médecine
GUITTON Christophe	MEDECINE INTENSIVE-REANIMATION	Médecine
LAVIGNE Christian	MEDECINE INTERNE	Médecine
PICCOLI Giorgina	NEPHROLOGIE	Médecine

POMMIER Pascal	CANCEROLOGIE-RADIOTHERAPIE	Médecine
SAVARY Dominique	MEDECINE D'URGENCE	Médecine
PLP		
CHIKH Yamina	ECONOMIE-GESTION	Médecine

REMERCIEMENTS

Au Professeur Jean-Daniel Kun-Darbois, pour son accompagnement et ses conseils avisés. Merci pour votre investissement dans ce travail et tout au long de mon internat.

Au Professeur Laurent Laccourreye que je remercie chaleureusement pour sa constante disponibilité et sa gentillesse. Merci de présider le jury de cette thèse.

Au Professeur Boris Laure, j'ai beaucoup apprécié et appris lors des 3 mois de stage à vos côtés à Tours. Merci d'avoir accepté de faire partie de ce jury de thèse.

Au Docteur Louis Rony que je remercie pour sa présence dans mon jury de thèse.

Aux Docteurs Alexandre Gueutier, Lucas Marti-Flich et Mathieu Provost. C'est un plaisir de travailler à vos côtés. Merci pour votre gentillesse et votre pédagogie.

À Pierre, co-interne puis chef, je tiens à adresser toute ma reconnaissance pour son soutien constant et son amitié sincère. Même si nos chemins professionnels se séparent, je suis certaine que notre amitié perdurera.

Je remercie tout particulièrement mes parents, pour leur soutien indéfectible, leur patience et leur présence constante tout au long de ces longues années d'études. Leur confiance et leur amour m'ont permis d'avancer.

À mon grand-frère Mathieu, pour son soutien précieux. Merci d'avoir essuyé les tempêtes lors de ma première année de médecine.

À ma sœur Julie, pour sa force tranquille et notre belle complicité. Je suis fière du chemin qu'elle trace et heureuse de l'avoir toujours à mes côtés.

Mes pensées vont également à mes grands-parents, et en particulier à papi Jo, pour les week-ends ressourçants en Bretagne et ses appels téléphoniques hebdomadaires.

À Ignacio, pour sa présence à mes côtés au quotidien. J'ai passé 3 merveilleuses années à tes côtés, hâte de découvrir ce que nous allons vivre ensemble les années à venir.

À mon amie Marion avec qui nous avons tissés des liens dès le début de l'internat et avec qui j'apprécie passer du temps.

À mes amis d'Angers et notamment Clémentine, Simon, Arthur, Charlotte et Émeline. Merci pour ces merveilleuses années Angevines et pour les prochaines à venir.

À mes amis des Sables d'Olonne. Je pense notamment à Marcelline, Capucine et Mathilde. Nathan avec qui je partage les mêmes études depuis la petite section, Omar mon super binôme d'externat, et bien d'autres.

Je remercie également les Sports Nautiques Sablais, et tout particulièrement Gaël, pour m'avoir transmis la passion de la voile, et pour ces instants précieux passés en mer.

À mes co-internes, pour leur bonne humeur constante. Leur présence a contribué à faire de ces années d'internat une expérience enrichissante et humaine.

REMERCIEMENTS

À la "team" de chirurgie plastique, ORL et maxillo-faciale, merci pour la cohésion, l'ambiance conviviale et le soutien mutuel.

À l'équipe paramédicale des consultations de chirurgie maxillo-faciale, pour leur aide précieuse tout au long de mon parcours. Une mention particulière à Anne, véritable pilier du service.

A l'équipe infirmière de la Fédération des Spécialités avec qui il est toujours un plaisir de collaborer.

À toutes les gentilles personnes que j'ai pu rencontrer lors de mes différents stages, et notamment Clémentine, Damien, Simon, Youssef, Arthur, Clément, Diane, Godefroy, Margaux, Hélène, Cerise, Suzanne et bien d'autres.

Je remercie l'ensemble de l'équipe de chirurgie thoracique et vasculaire, auprès de laquelle j'ai effectué mon premier semestre d'internat. Merci pour votre accueil et pour m'avoir fait découvrir les exigences et la richesse de votre spécialité.

Au Docteur Frédéric Grosier, chirurgien viscéral, chez qui j'ai effectué mon stage de 3ème, et grâce à qui j'ai trouvé ma voie en médecine.

LIST OF ABBREVIATIONS

BSSO	Bilateral sagittal split osteotomy
NSAIDs	Non-steroidal anti-inflammatory drugs
MFS	Maxillofacial surgeons
AFJCMF	Association française des jeunes chirurgiens maxilllo-faciaux
SFSCMFCO	Société française de stomatologie, Chirurgie Maxillo-faciale et Chirurgie Orale
AFCF	Association française des chirurgiens de la face

PLAN

Bone graft in bilateral mandibular sagittal split osteotomy: the current state of practice in France

C. Billon[1*], C. Moreau [3], A. Rohée-Traoré[1], A. Gueutier [1,]2, J.D. Kün-Darbois [1,2]

[1] CHU Angers, Service de Chirurgie Maxillo-faciale, F-49933 Angers, France

[2] Univ Angers, Nantes Université, Oniris, Inserm, RMeS, REGOS, SFR ICAT, F-49000 Angers, France

[3] CHU Angers, Direction de la Recherche Clinique et de l'Innovation, F-49933 Angers, France

ABSTRACT

Introduction: Bilateral sagittal split osteotomy of the mandible (BSSO) is the most common orthognathic surgery procedure. The use of bone grafting seems widely used whereas its interest has not been shown to date. The aim of this study was to describe the current state of practice of bone graft in BSSO in France.

Materials and methods: An online survey was used to collect data about the use of bone grafting in BSSO procedures among French maxillofacial surgeons.

Results: One hundred and forty-eight surgeons responded to the survey, mostly maxillo-facial surgeons (96%). Only 31.8% of participants had already performed grafts in BSSO and the majority did it in less than 10% of cases. The main grafting indication was the degree of advancement especially for advances over 10mm. Different types of grafts were used, mainly: autologous bone grafting (mandibular or hip) or other bone grafting (xenograft, allograft).

Conclusion: This survey shows the diversity of practices in France regarding the use of grafting in BSSO. Further studies are needed to investigate prospectively the utility of such procedures.

INTRODUCTION

Bilateral sagittal split osteotomy of the mandible (BSSO) is one of the most commonly used orthognathic surgical techniques to correct mandibular deformities, particularly mandibular retrognathism (i.e. Angle class II). The procedure aims to achieve a functional and esthetic outcome by restoring normal dental occlusion (i.e. Angle class I) and improving facial harmony. However, despite its overall reliability, several intraoperative and postoperative complications may arise, such as unfavorable bone healing and defects at the mandibular inferior border. These complications are influenced by various patient and surgery-related factors, including patient's background, the degree of mandibular advancement (>10mm), and surgical technique[1–3].

Bone grafting at the osteotomy site has been proposed as a strategy to enhance healing and reduce complications, particularly in large advancements. Autologous grafts (mandibular, maxillar, cranial, hip or teeth harvesting), xenografts, allografts, and biomaterials such as titanium or ceramic have been used in clinical practice[4]. While evidence supports the utility of bone grafts in maxillary osteotomies (e.g., Le Fort I) to promote bone union and stability[5–7], data on their effectiveness in BSSO remain scarce. Only a few studies have addressed their role in preventing defects at the mandibular border or pseudarthrosis, and no consensus exists regarding the best indications or materials to use[8–12].

The aim of this study was to assess and describe the current practices regarding bone grafting in BSSO among French orthognathic surgeons through a nationwide online survey, in order to better understand prevailing trends and inform future clinical recommendations.

MATERIALS AND METHODS

1. Design of the study and target population

A prospective multicentric observational study was designed. All the facial surgeons, of private or public exercise, who usually perform orthognathic surgery in France, were targeted to participate to the study. It includes maxillofacial surgeons (MFS) but also a few other specialty surgeons (otorhinolaryngologists or plastic surgeons and stomatologists). Their email addresses were collected using databases of all the main national French associations of MFS (i.e. Association française des jeunes chirurgiens maxillo-faciaux (AFJCMF), Société française de stomatologie, Chirurgie maxillo-faciale et Chirurgie orale (SFSCMFCO) et Association française des chirurgiens de la face (AFCF)). All the surgeons working in the departments of maxillofacial surgery in French public hospitals have also been invited to participate to the study.

Invitations to participate to the survey were sent by e-mails addressed to every surgeon and head of department: one invitation e-mail followed by at least 4 reminder e-mails. The data collection period lasted four months, from December 2023 to March 2024.

2. Survey design

The online survey was designed using the Sphinx platform (Sphinx Declic 4.30, Chavanod, France) and emailed to the participants.

The survey is reported in Table I. It include 17 questions related to:

- Surgeon's characteristics (identity, specialty, experience in orthognathic surgery, type of exercise (private or public))
- Surgeon’s habits in bone grafting (indications, type of graft, etc…)
- Personal comments

Table I. Online survey.

Questions about the surgeon	
Name	…
First name	…
Speciality	Maxillo-facial surgery Other : …
Place of practice (among French departments)	…
Type of exercise	Public Private Mixed
Status in the case of public or mixed practice	Praticien Hospitalier (PH) (i.e. Hospital practitioner) Praticien Hospitalier Contractuel (PHC) (i.e. contractual Hospital practitioner) Praticien Hospitalier Universitaire (PHU) (i.e. Universitary and Hosptial practitioner) Maître de conférences des universités et Praticien hospitalier (MCUPH) (i.e. Assistant Professor and Hospital Practitioner) Professeur des Universités et Praticien hospitalier (PUPH) (i.e. University Professor and Hospital Practitioner) Chef de clinique, Assistant Hospitalier (i.e. Medical Fellow) Other : …
Years of experience in orthognathic surgery *Without initial formation (residency)*	<5 years Between 5 and 15 years >15 years
Questions about the surgeon's practices	
Average number of mandibular osteotomies per year	<20 Between 20 and 50 Between 50 and 100 >100
Type of mandibular ostotomy	Epker Obwegeser-Dalpont Hunsuck Supra-basilaire Other : …
Grafts	Yes No
Questions if you answer yes to "grafts"	
Proportion of mandibular osteotomies with grafts	<10% Between 10 and 50% >50%
Type of graft	Autologous bone grafting, mandibular harvesting Autologous bone grafting, cranial harvesting Autologous bone grafting, hip harvesting Other bone grafting (xenograft, allograft) Biomaterial (titanium, ceramic, …) Other : …
Grafts indications	Systematic indication Degree of advancement Presence of an intraoperative notch Stability of the surgical set-up Type of osteosynthesis Type of osteotomy Patient background Other: …
In case of degree of advancement in the previous question, degree of advancement from which a bone graft performed	>6mm >8mm >10mm >12mm Other: …
Open questions	
Details about grafts indications	…
Trigger(s) that led to grafting or element(s) that made people stop grafting	…
Free text commentary	…

3. Ethical approval

The approval of an ethic committee was not necessary given the type of study carried out (cross-sectional descriptive study). The study was conducted in accordance with the institutional guidelines of the French Ethical Committee and with the 1964 Helsinki declaration and its later amendments.

4. Data analysis

All statistical analyses were performed using R software (version 4.0.5). Descriptive statistics were expressed as numbers (%) for all qualitative variables. To compare the characteristics of surgeons from the private/mixed sector versus those from the public sector, Exact Fisher tests were performed. For participants performing grafts in BSSO, the number of indications for grafting were presented via the median with 1st and 3rd quartiles. A comparison of the number of indications ticked between public and private/mixed surgeons was performed using a Mann-Whitney test. Finally, the minimum degree of advancement according to which surgeons graft was compared between the two previously mentioned groups via a Cochran-Armitage test. Differences were considered statistically significant when a p-value < 0.05.

RESULTS

1. Participant's characteristics and surgical practices

Of the 256 surgeons contacted for this study, 148 (57.8%) returned the completed questionnaire.

About twenty of these 256 surgeons did not perform the survey since they did not perform orthognathic surgery or had retired. The geographic distribution of the participants is shown in Figure 1. Table II shows the characteristics of the study participants. Almost all participants were maxillofacial surgeons (96.6%). The medical specialty was not specified for only one respondent. The most performed type of osteotomy was the Epker osteotomy (75.0%) followed by Obwegeser-Dalpont osteotomy (15.5%). It is interesting to note that all types of exercise were represented. A few differences could be observed between private/mixed surgeons versus public surgeons. Surgeons from the mixed and private sectors were more experienced (p-value = 0.002) and were more numerous to perform graft in BSSO (p-value = 0.005) than those from the public sector. Only 47 (i.e. 31.8%) of the 148 participants had already performed grafts in BSSO.

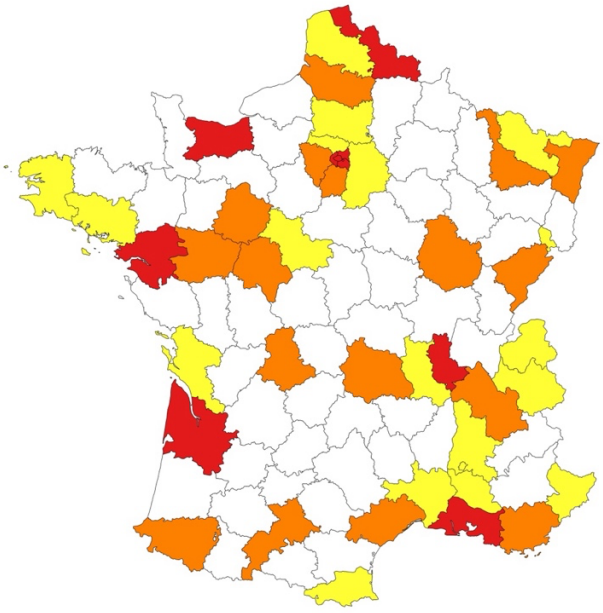

Figure 1. Geographical breakdown of participants (yellow<1%; orange 1-5%; red >5%).

Table II. Descriptive of participant's characteristics and surgical practice (n= 148).

	All surgeons n = 148	Private & mixed practice n = 78	Public practice n = 70
Exercise type			
Mixed	30 (20.3%)	30 (38.5%)	0 (0.00%)
Private	48 (32.4%)	48 (61.5%)	0 (0.00%)
Public	70 (47.3%)	0 (0.00%)	70 (100%)
Speciality			
Maxillofacial surgeons	143 (96.6%)	74 (94.9%)	69 (98.6%)
Stomatologist	2 (1.35%)	2 (2.56%)	0 (0.00%)
Otorhinolaryngologist	1 (0.68%)	1 (1.28%)	0 (0.00%)
Plastic surgeon	1 (0.68%)	1 (1.28%)	0 (0.00%)
Others	1 (0.68%)	0 (0.00%)	1 (1.43%)
Experience, years			
<5	44 (29.7%)	15 (19.2%)	29 (41.4%)
5-15	64 (43.2%)	34 (43.6%)	30 (42.9%)
>15	40 (27.0%)	29 (37.2%)	11 (15.7%)
Number of BSSO, per year			
<20	53 (35.8%)	24 (30.8%)	29 (41.4%)
20-50	49 (33.1%)	20 (25.6%)	29 (41.4%)
50-100	17 (11.5%)	10 (12.8%)	7 (10.0%)
>100	29 (19.6%)	24 (30.8%)	5 (7.14%)
Osteotomy type			
Kater (High osteotomy)	2 (1.4%)	2 (2.6%)	0 (0.00%)
Epker	111 (75.0%)	58 (74.4%)	53 (75.7%)
Epker modifié	1 (0.7%)	1 (1.3%)	0 (0.00%)
Hunsuck	2 (1.4%)	0 (0.00%)	2 (2.86%)
Hunsuck-Epker	1 (0.7%)	0 (0.00%)	1 (1.43%)
Obwegeser-Dalpont	23 (15.5%)	14 (17.9%)	9 (12.9%)
Obwegeser-Epker	1 (0.7%)	1 (1.3%)	0 (0.00%)
Loncle (Supra-basilar osteotomy)	7 (4.7%)	2 (2.6%)	5 (7.14%)
Grafts in BSSO	47 (31.8%)	33 (42.3%)	14 (20.0%)

2. *Graft practices characteristics*

Table III gives details on graft practices characteristics in BSSO among the 47 surgeons performing grafts. It seems that surgeons practicing in the private/mixed sector transplanted more frequently than surgeons in the public sector, although this was not significant.

A few surgeons declared to use more than one type of graft, this fact explains that there are more than 47 responses for this item. Many different types of grafts were used: autologous bone grafting (mandibular, maxillar, cranial, or hip), other bone grafting (xenograft, allograft). Maxillar bone harvest was performed only in case of associated Le Fort I osteotomy. No other type of biomaterial (titanium, ceramic) were used.

The main indication that prompted surgeons to perform grafts was the degree of mandibular advancement (78.7%). Other main indications were the patient background (34%) and the presence of an intraoperative notch (25.5%). It is interesting to note that only 5 surgeons (10.6%) declared to systematically perform bone grafting in BSSO. The main indications are shown in Figure 2.

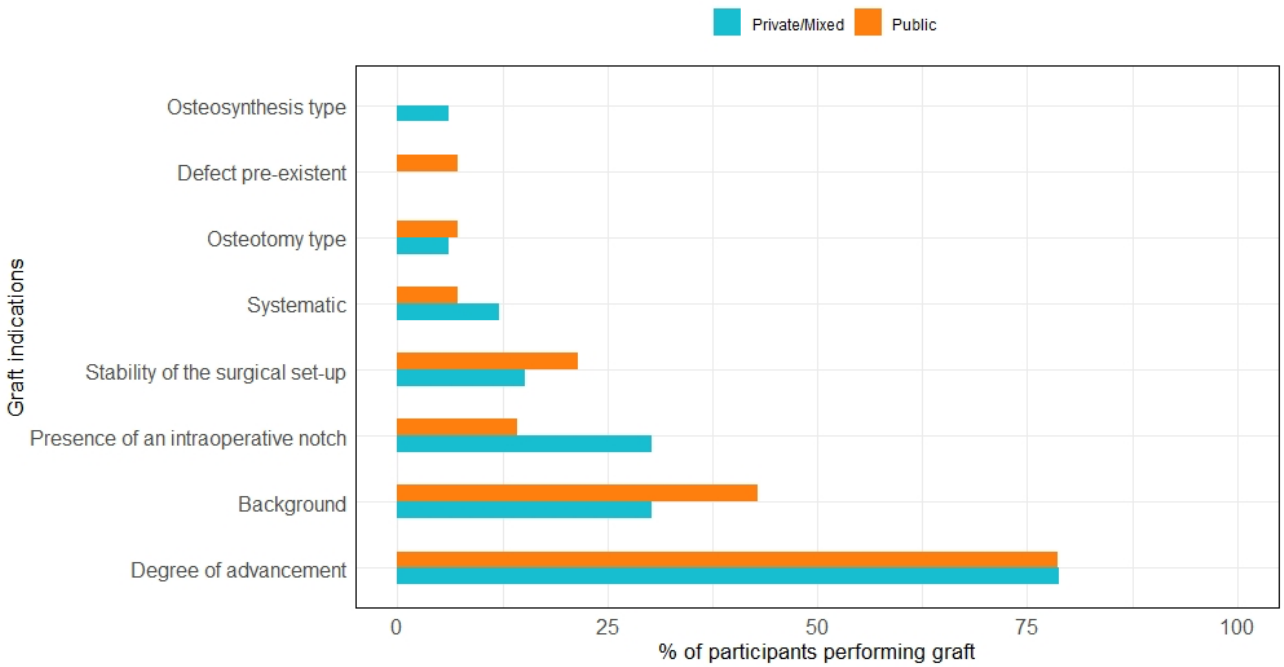

Figure 2. Indications of grafts between public and private/mixed surgeons.

Table III. Descriptive of participants who had already performed grafts in BSSO (n = 47).

	All surgeons n = 47	Private & mixed practice n = 33	Public practice n = 14
Proportion of osteotomy time with graft, %			
<10%	26 (55.3%)	16 (48.5%)	10 (71.4%)
10-50%	13 (27.7%)	10 (30.3%)	3 (21.4%)
>50%	8 (17.0%)	7 (21.2%)	1 (7.14%)
Graft types			
Autologous bone grafting (mandibular, maxillar), yes	14 (29.8%)	7 (21.2%)	7 (50.0%)
Autologous bone grafting (cranial), yes	1 (2.13%)	0 (0.00%)	1 (7.14%)
Autologous bone grafting (hip), yes	5 (10.6%)	3 (9.09%)	2 (14.3%)
Other bone grafting (xenograft, allograft), yes	35 (74.5%)	26 (78.8%)	9 (64.3%)
Graft indications			
Systematic, yes	5 (10.6%)	4 (12.1%)	1 (7.14%)
Degree of advancement, yes	37 (78.7%)	26 (78.8%)	11 (78.6%)
Background, yes	16 (34.0%)	10 (30.3%)	6 (42.9%)
Stability of the surgical set-up, yes	8 (17.0%)	5 (15.2%)	3 (21.4%)
Presence of an intraoperative notch, yes	12 (25.5%)	10 (30.3%)	2 (14.3%)
Osteosynthesis type, yes	2 (4.26%)	2 (6.06%)	0 (0.00%)
Osteotomy type, yes	3 (6.38%)	2 (6.06%)	1 (7.14%)
Pre-existing defect, yes	1 (2.13%)	0 (0.00%)	1 (7.14%)

Figure 3 shows the proportion of surgeons who performed graft according to the exact degree of advancement (in mm) at which the indication for bone grafting is retained. It is interesting to note that the degree of advancement of 10 mm is the most chosen but also that many surgeons perform bone grafting for smaller degree of advancement (6 mm). This figure also shows very interestingly that the higher the degree of advancement was, the more public surgeons performed bone grafting unlike private or mixed surgeons who performed grafting independently from the degree of advancement.

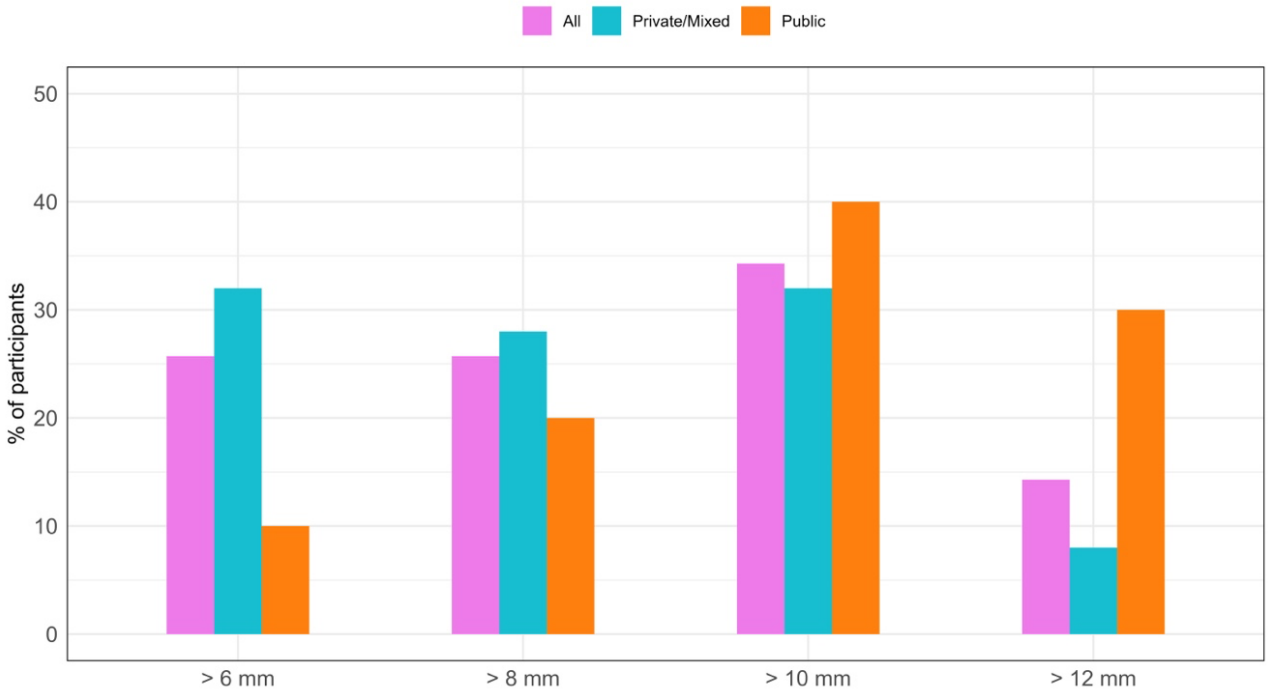

Figure 3. Degree of advance.

3. Comparative analysis of graft practice according to participant's characteristics

Regarding the type of activity of surgeons performing grafts, 14 (29.8%) had a public practice and 33 (70.2%) had a private or mixed practice (Table III). No difference could be observed regarding the number of retained indications of graft between private and public practice surgeons (p= 0.970). There was also no significant difference (p-value = 0.052) for the degree of advancement required for grafting between public and private/mixed surgeons.

4. Qualitative outcomes: expressed free comments

The open-ended comments were mainly about the pros and cons of grafting based on the surgeon's personal experience. Many surgeons consider bone grafting beneficial for the correction or prevention of the notch, the reduction of the risk of pseudarthrosis and the stability of the surgical set-up. Some surgeons consider that post-operative edema can be prevented by bone grafting while others think the contrary. A few participants consider other bone grafting systematic indications: bad-split occurrence, complex malformation surgery or

asymmetry correction. Some surgeons consider that bone grafting should be considered only secondarily in case of post-operative complications such as the occurrence of pseudarthrosis or a notch. On the other hand, a few surgeons raised some negative consequences regarding bone grafting: increased risk of infection and increased operating time.

DISCUSSION

Through this questionnaire, we sought to examine the practices of surgeons in France concerning the use of grafts in BSSO, as no standardized guidelines currently exist.

Out of a total number of 1000 maxillo-facial surgeons in France, it is estimated that only 500 of them regularly perform orthognathic surgery. We can say that a number of 148 responding surgeons in the present study can thus be considered as representative of current practice since it represents 29.6% of the total of orthognathic practicing surgeons. In addition, participants were geographically distributed throughout France.

Only 31.8 % of orthognathic surgeons had ever performed grafts and the indications that standed out, although not significant, seemed to be the degree of advancement (especially for advancements greater than 10mm), the patient background and the presence of an intraoperative notch.

The 10 mm advancement threshold appears to be a critical factor influencing grafting decisions. This threshold can be explained by biomechanical principles: when mandibular advancement exceeds 10 mm, there is often reduced contact between the proximal and distal bony segments at the osteotomy site, particularly at the inferior mandibular border. This creates a void that compromises the surface area available for natural bone healing. Additionally, large advancements generate increased tension in adjacent soft tissues, exerting unfavorable forces on the fixation system and bony segments, which may lead to instability, pseudarthrosis, or formation of a notch. Bone grafts, in such cases, can serve both as space fillers and structural supports, enhancing stability and facilitating bone regeneration. Several studies have shown that the use of grafts (particularly allografts) may reduce the occurrence of lower border defects in cases of large advancements[2,10,13–15].

Based on the study results and consistent with available literature, the main indications for bone grafting during BSSO can be grouped into four categories (Table IV). First, the degree of

mandibular advancement, particularly when exceeding 10 mm, was the most commonly cited indication. In such cases, the risk of inferior border defects, mechanical instability, and non-union increases due to insufficient bony contact between segments. Second, intraoperative findings, such as the presence of a visible notch or step-off between segments, may prompt the surgeon to perform immediate grafting to restore mandibular contour and continuity. Third, patient-related risk factors including age, active smoking, underlying diseases, and treatments such as non-steroidal anti-inflammatory drugs (NSAIDs)[3] are often considered as indications to reinforce bone regeneration with grafts. Finally, specific surgical scenarios, such as cases involving congenital or acquired malformations, facial asymmetries, or the occurrence of a bad split, may justify the use of grafts to ensure stability and minimize the risk of postoperative complications. In some cases, surgeons reported using bone grafts secondarily, in response to complications such as pseudarthrosis or persistent defects. These heterogeneous practices underline the lack of consensus in the field and reinforce the need for clinical studies to establish standardized grafting indications in BSSO.

Table IV: Main type of indications to perform bone grafting in BSSO.

I	**II**	**III**	**IV**
= Degree of mandibular advancement	*= Intraoperative findings*	*= Patient-related risk factors*	*= Specific surgical scenarios*
No consensus has been reached to date.	Presence of visible notch Step-off between segments …	Age Active smoking Underlying diseases Treatments (NSAIDs) …	Congenital malformations Acquired malformations Facial asymmetries Bad split …

In this study, xenografts and allografts were more used than autologous grafts (74.5% *vs* 36.13%). This might be explained by a few differences between autologous and other grafts: no harvesting, no morbidity of the donor site, malleability of the sample. However, the gold standard remains autologous grafts because of its osteointegration capacity and its compatibility with the host[13,16].

No statistically significant difference was found in grafting indications between public and private/mixed surgeons. Nevertheless, a trend was observed whereby surgeons in the private/mixed sector used grafts more frequently and tended to prefer xenografts and allografts, while public sector surgeons made more use of autologous grafts. Finally, our results suggest a discrepancy between perceived usefulness and actual frequency of grafting, with many surgeons performing it in fewer than 10% of cases. This may reflect the ongoing debate over its preventive value versus its role in salvage situations. Clarifying the risk-benefit ratio of grafting in BSSO (particularly in large advancements) remains a priority for future research.

This study has some limitations. As it was based on a voluntary online survey, it is subject to response bias. Despite this, the study achieved a broad geographic and professional coverage, providing meaningful insights into current clinical practices in France.

In conclusion, our findings reveal the variability in grafting practices among French surgeons performing BSSO. While bone grafting is not systematically performed, it is more commonly indicated in cases of large mandibular advancements or when risk factors for poor healing are present. These results call for further prospective and comparative studies (both national and international) to better define the indications, materials, and outcomes of bone grafting in BSSO and ultimately develop evidence-based guidelines.

BIBLIOGRAPHIE

[1] Verweij JP, Van Rijssel JG, Fiocco M, Mensink G, Gooris PJJ, Van Merkesteyn JPR. Are there risk factors for osseous mandibular inferior border defects after bilateral sagittal split osteotomy? J Cranio-Maxillofac Surg 2017;45:192–7.

[2] Agbaje JO, Sun Y, Vrielinck L, Schepers S, Lambrichts I, Politis C. Risk Factors for the Development of Lower Border Defects After Bilateral Sagittal Split Osteotomy. J Oral Maxillofac Surg 2013;71:588–96.

[3] Gaston MS, Simpson A. Inhibition of fracture healing. J Bone Surg. British Vol. 2007; 89-B(12), 1553-1560.

[4] Louis PJ. Bone grafting the mandible. Dent Clin North Am. 2011;55(4):673-95.

[5] Zanettini LMS, Fritscher GG, De Marco RG, de Oliveira Andriola F, Pagnoncelli RM. Bone Substitutes in Le Fort I Osteotomy to Promote Bone Union and Skeletal Stability. J Craniofac Surg 2017;28:492–5.

[6] Lye KW, Deatherage JR, Waite PD. The Use of Demineralized Bone Matrix for Grafting During Le Fort I and Chin Osteotomies: Techniques and Complications. J Oral Maxillofac Surg 2008;66:1580–5.

[7] Sharma AP, Stringer DE. Autogenous Mandibular Bone Graft for Maxillary Le Fort I Osteotomy Interpositional Gap in Orthognathic Surgery: A Technique Case Series. J Oral Maxillofac Surg 2019; 77(5):1068.e1-1068.e36

[8] Kang MG, Yun KI, Kim CH, Park J-U. Postoperative Condylar Position by Sagittal Split Ramus Osteotomy With and Without Bone Graft. J Oral Maxillofac Surg 2010;68:2058–64.

[9] Agbaje JO, Gemels B, Salem AS, Anumendem D, Vrielinck L, Politis C. Modified Mandibular Inferior Border Sagittal Split Osteotomy Reduces Postoperative Risk for Developing Inferior Border Defects. J Oral Maxillofac Surg 2016;74:1062.e1-1062.e9.

[10] Trevisiol L, Nocini PF, Albanese M, Sbarbati A, D'Agostino A. Grafting of Large

Mandibular Advancement With a Collagen-Coated Bovine Bone (Bio-Oss Collagen) in Orthognathic Surgery: J Craniofac Surg 2012;23:1343–8.

[11] Stoor P, Apajalahti S. Osteotomy Site Grafting in Bilateral Sagittal Split Surgery With Bioactive Glass S53P4 for Skeletal Stability. J Craniofac Surg 2017;28:1709–16.

[12] Da Hora Sales PH, Maffìa F, Vellone V, Ramieri V, Leão JC. Is it necessary to use bone grafts to prevent defects at the lower border of the mandible after mandibular advancement?—a systematic review. Oral Maxillofac Surg 2022;27:581–9.

[13] Burchardt H. The biology of bone graft repair. Clin Orthop Relat Res. 1983;(174):28-42.

[14] Cifuentes J, Yanine N, Jerez D, Barrera A, Agbaje JO, Politis C. Use of Bone Grafts or Modified Bilateral Sagittal Split Osteotomy Technique in Large Mandibular Advancements Reduces the Risk of Persisting Mandibular Inferior Border Defects. J Oral Maxillofac Surg 2018;76:189.e1-189.e6.

[15] Alyahya A, Swennen GRJ. Bone grafting in orthognathic surgery: a systematic review. Int J Oral Maxillofac Surg 2019;48:322–31.

[16] Albrektsson T, Johansson C. Osteoinduction, osteoconduction and osseointegration. Eur Spine J. 2001;10 Suppl 2(Suppl 2):S96-101.

LEGENDS OF FIGURES

TABLES

TABLE DES MATIÈRES

Publication:

Ce travail a été soumis le 03/04/2025 sous la forme d'un article original dans la revue «Journal of Stomatology oral and Maxillofacial Surgery » (Impact Factor : 1.8).

BILLON Charlotte

Etat des lieux sur les pratiques en France de la greffe dans le foyer d'ostéotomie lors des chirurgies d'avancée mandibulaire

RÉSUMÉ

Introduction : L'ostéotomie sagittale bilatérale du ramus de la mandibule (OSBM) est une intervention très fréquente en chirurgie orthognathique. L'utilisation de greffe osseuse dans le foyer d'ostéotomie semble de pratique courante bien que peu documentée. L'objectif de cette étude est de décrire les pratiques courantes en France concernant la réalisation de greffe osseuse dans le foyer d'ostéotomie lors des OSBM.

Matériels et méthodes : Un questionnaire national a été réalisé et transmis aux chirurgiens pratiquant de la Chirurgie orthognathique en France.

Résultats : Cent-quarante-huit chirurgiens ont répondus au questionnaire, majoritairement des Chirurgiens Maxillofaciaux (96%). Seulement 31,8% des participants disent avoir déjà réalisé une greffe dans le foyer d'ostéotomie lors d'une OSBM et la majorité le font dans moins de 10% des cas. La principale indication est le degré d'avancée mandibulaire surtout pour les avancées de plus de 10mm. Différents types de greffes sont utilisées : greffe autologue (mandibule ou hanche), autre type de greffe osseuse (xénogreffe, allogreffe).

Conclusion : Cette étude montre la diversité des pratiques en France concernant la réalisation des greffes dans le foyer d'ostéotomie lors des OSBM. D'autres études prospectives semblent nécessaires pour évaluer l'intérêt de telles pratiques.

Mots-clés : Greffe osseuse ; Chirurgie Maxillo-faciale ; Chirurgie orthognathique

Bone graft in bilateral mandibular sagittal split osteotomy: the current state of practice in France

ABSTRACT

Introduction: Bilateral sagittal split osteotomy of the mandible (BSSO) is the most common orthognathic surgery procedure. The use of bone grafting seems widely used whereas its interest has not been shown to date. The aim of this study was to describe the current state of practice of bone graft in BSSO in France.

Materials and methods: An online survey was used to collect data about the use of bone grafting in BSSO procedures among French maxillofacial surgeons.

Results: One hundred and forty-eight surgeons responded to the survey, mostly maxillo-facial surgeons (96%). Only 31.8% of participants had already performed grafts in BSSO and the majority did it in less than 10% of cases. The main grafting indication was the degree of advancement especially for advances over 10mm. Different types of grafts were used, mainly: autologous bone grafting (mandibular or hip) or other bone grafting (xenograft, allograft).

Conclusion: This survey shows the diversity of practices in France regarding the use of grafting in BSSO. Further studies are needed to investigate prospectively the utility of such procedures.

Keywords: Bone grafting; Maxillofacial surgery; Orthognathic surgery

FACULTÉ DE SANTÉ
UNIVERSITÉ D'ANGERS