POSTERS

P8 - COMPUTER AIDED DESIGN AND MANUFACTURE (CAD/CAM) OF AN EYE EPITHESIS WITH OSSEOINTEGRATED RETENTION

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KEYWORDS
Facial prosthesis, osseointegrated orbital reconstruction, CAD/CAM

INTRODUCTION
The loss of an organ like the eye prevents the reconstructive surgery. The facial prosthesis (epithesis) becomes the only reconstructive solution. These epithesis allow patients to regain harmony in their altered face. Among the possible artifice to retain these prostheses (goggles, rubber bands, glues), the best way to ensure stability is to use extra-oral implants. The standard protocol for developing these epithesis and the
placement of the implants are quite laborious with many risks of errors on many steps. Our project is therefore, by computer aided design and manufacture (CAD/CAM), to facilitate the implementation of these implants and the achievement of epithesis anticipating the placement of implant according to the prosthetic profiles.

MATERIALS AND METHODS
Design of the surgical guide.
This design is obtained using the DICOM data from a post surgical scanner.
Computer modeling of the cutaneous surface and bone surface of the orbit: using the software AMIRA® Figure 1a.
Design of the surgical guide: with Rhinoceros ® software different sections of the model are realized to assess the bone thickness and thus be able to determine the ideal position of the implants (Figure 1b). To account for the emergence of the implants and the volume of

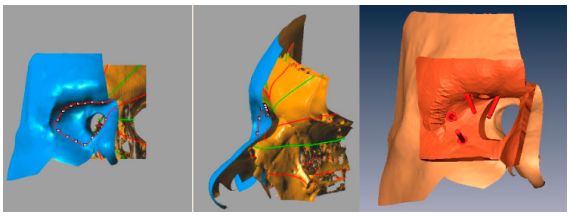

Figure 1. a) modeling the various structures and b) choice of implant sites and axes

the pillars, a template is superimposed on the surgical site. This template presents the shape of the future epithesis obtained due to a mirror effect of the area of the healthy eye. This method allows us to anticipate the thickness of the epithesis and so preserve its aesthetic rendering.
Virtual guide prototype: in technology "off set ", we shift the initial surface to obtain thickness.
Simulation of possible implant positions: these positions are determined by the treatment area, the line where the implants can be placed and the axes of the implants depending on the bone thickness.

MANUFACTURE OF SURGICAL GUIDE
The materialization of the layout of the patient's facial structures is achieved by rapid prototyping using resin stereolithography. The guide is improved with surgical drill guides whose calibration is determined according to the surgeon's wishes. The surgical site requires a degreasing of the skin surface. A flap is necessary and returned to the center of the guide on which a path is opened. The repositioning of the guide must be very precise. For reasons of hygiene and hospital standards in

terms of sterilization, the prototype was made of titanium sintered by SIRRIS (Charleroi) (Figure 2).

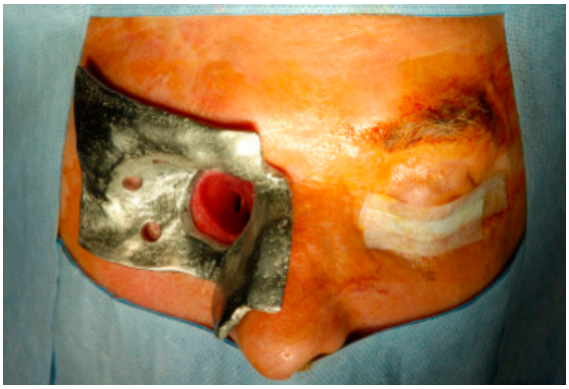

Figure 2. The surgical guide

DESIGN AND MANUFACTURE OF EPITHESIS

The underside of the epithesis will receive the retention elements (magnets). We must use a rigid material for this part. It is computer designed by reduction of the skin surface repositioned by mirroring the unaffected side. The volumes of the substructure pillars are also provided.

We manufactured by machining a block of dental resin. The lost wax process is used to construct the superficial part. The mold is invested by the silicone-dyed. The make-up of the surface is done in a conventional manner.

SURGICAL PHASES

The surgeon begins by positioning the guide and by marking the skin at the future implant sites. Then he realizes the flap design, incises and displaces the tissue to the orbital cavity. It replaces the guide and directed drilling. Four Vistafix ™ implants are placed and protected by screws.

The flap is repositioned and sutured. Given the fragility of the surgical site, a phase of osseointegration under skin coverage is necessary before the final discovery of the implants. The second surgical stage is to find the fixtures, redesign peri-implant sites by refining the skin to reduce the risk of infection in these areas of transcutaneous permanent communication. The healing abutments are in place for a few weeks. The healing abutments are replaced with magnetic pillars.

RESULTS

After this osseointegration phase of a few months, we can complete the cosmetic part of the epithesis and add retainers initially planned (magnets). All implants were osseointegrated and the skin around the pillars appears very healthy. The rules of hygiene must be fully explained to the patient to avoid any risk of infection.

DISCUSSION

Retention achieved with implant systems (ie magnets) is very safe and comfortable for the patient. Oncologic surveillance or a future reconstruction surgery is not disturbed by the implants. Similarly, the removable epithesis authorizes a healthy site. The precision of the surgery is improved: the sites can be selected according to their higher density and bone implants provide an ideal orientation to the contours and volumes of future epithesis. The second stage procedure is simplified with direct location of the implants through the guide and by discovering the fixtures by coring percutaneous technique. CAD/CAM eliminates the facial impression often unpleasant for the patient as well as errors related to this impression. It happens to reduce the number of appointments needed to develop such prosthesis. Our approach should lead to achieving almost total CAD/CAM process. We are working on the manufacturing phase of a wax model of the outer part, which will be replaced by tinted silicone and makeup. The choice of a digital scanning process authorizing open eye is essential. CAD will anticipate the location of the artificial iris. This model will be a mirrored replica of the contralateral healthy side. No CAM process uses this material. The positioning of the iris and the silicone work will be the only manual steps for the epithesist.

CONCLUSION

Computer aided design and manufacture (cad-cam) can reduce the overall processing time, increase the accuracy of surgery and the quality of epithesis. They therefore represent a promising technique for all these people maimed by life, that reconstructive surgery couldn't help. We propose to finalize the development of the wax pattern to be replaced by tinted silicone (the simulated skin) through the use of an optical or holographic sensor.

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POSTERS

P8 - CONCEPTION ET FABRICATION ASSISTÉES PAR ORDINATEUR (CFAO) D'UNE ÉPITHÈSE OCULO-PALPÉBRALE IMPLANTO-PORTÉE

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MOTS CLÉS
Prothèse maxillo-faciale, implantologie extra-orale (mot libre), CFAO_Systeme de

INTRODUCTION
La perte d'un organe tel que l'œil est encore incompatible avec la chirurgie réparatrice et reconstructrice.
La prothèse faciale (épithèse) devient la seule solution de reconstruction. Ces épithèses permettent aux patients de retrouver l'harmonie de leur visage altéré.
Parmi les artifices possibles pour retenir ces prothèses (lunettes, élastiques, colles), le meilleur moyen de garantir une bonne stabilité est de recourir aux implants extra-oraux.
Le protocole classique d'élaboration de ces épithèses et la mise en place des implants sont assez laborieux avec des risques d'erreurs sur beaucoup d'étapes. Notre projet consiste donc, grâce à la conception et la fabrication assistées par ordinateur (CFAO), à faciliter la mise en place de ces implants et la réalisation de l'épithèse en anticipant le positionnement des implants selon les profils prothétiques.

MATÉRIEL ET MÉTHODE
Conception du guide chirurgical.
Cette conception se fait à partir de l'exploitation du scanner post chirurgical du patient.
Modélisation sur ordinateur de la surface cutanée et osseuse de la cavité orbitaire : grâce au logiciel AMIRA® Figure 1a.
Conception du guide chirurgical : avec le logiciel RHINOCEROS® on réalise différentes sections du modèle pour évaluer l'épaisseur osseuse et ainsi pouvoir déterminer la position idéale des implants (figure 1b). Pour tenir compte de l'émergence des implants et du volume des piliers on superpose sur le site à appareiller un gabarit de la surface de la future épithèse obtenu un effet miroir de la zone de l'œil restant. Ce procédé permet d'anticiper l'épaisseur de l'épithèse et ainsi de préserver le rendu esthétique de la future épithèse,
Réalisation du prototype virtuel du guide : par la technique « off set » on prend la surface, et on la décale pour avoir de l'épaisseur.
Simulation des positions implantaires possibles : celles-ci sont déterminées par la zone à traiter, la ligne sur laquelle les implants peuvent êtres placés, ainsi que des axes des implants en fonction de l'épaisseur osseuse.

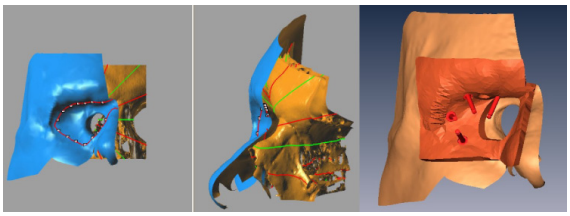
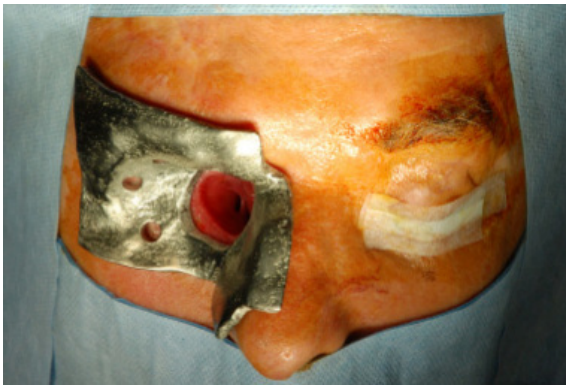


Figure 1. a)modélisation des différentes structures et b) choix des sites etaxes implantaires

FABRICATION DU GUIDE CHIRURGICAL
La matérialisation de la maquette des structures faciales du patient est réalisée par prototypage rapide par stéréolithographie de résine.
Le guide chirugical est aménagé avec des guides de forage dont le calibrage est établi selon les souhaits du chirurgien. Le site opératoire nécessite un dégraissage de la surface

cutanée. Un lambeau est nécessaire et ramené vers le centre du guide sur lequel passage est aménagé. Le repositionnement du guide doit rester très précis.
Pour des raisons d'hygiène et de normes hospitalière en terme de stérilisation le prototype a été réalisé en titane fritté par la société Sirris de Charleroi (figure 2).



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