AN OVERVIEW OF EXTRAORAL MAXILLOFACIAL PROSTHESIS MATERIALS

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Abstract
Unaesthetic maxillofacial defects decreases social acceptance. Prosthetic rehabilitation of facial defects makes the life easier with improved esthetics. Prosthetic restoration of such defects is an ancient art, in which success has always being limited by unavailability of adequate materials. The success of any facial prosthesis depends on the physical and mechanical properties of the material.
The rehabilitation of patients requiring not only the replacement of missing body part but also a loss of psychological confidence is a challenging task. Since maxillofacial defects lie on the face, the materials used for fabricating the prosthesis should fulfill a variety of requirements. At present, there is no ideal material which can be universally used. The scope of this article is in providing some background about the evolution and current trends in using these materials.
Key Words: Maxillofacial materials, Room temperature vulcanized, Silicone elastomers, Polyphosphazenes

INTRODUCTION

Maxillofacial prosthetics is the branch of prosthodonticsconcerned with the restoration and/or replacement ofthe stomatognathic and craniofacial structures with theprosthesis that may or may not be removed on a regular orelective basis (Glossary of Prosthodontic Terms).[1]It encompasses prosthetic rehabilitation of patient with oral, paraoral, or craniofacial defects which may be congenital or acquired resulting from disease or trauma.
Even before dentistry attained its status as a profession, some surgeons had recognized the limitations inherent in grafting tissue for repair of certain maxillofacial defects and had argued the use of prostheses as an alternate method. For facial rehabilitation assessment of materials used in maxillofacial prosthesis is necessary. Till date we have come across various materials which exhibit some excellent properties but also have many deficiencies. This article will review various materials used in maxillofacial prosthesis.

HISTORICAL BACKGROUND

BEFORE 1600

Archeologists have found artificial eyes, noses and ears constructed from waxes, clay and wood in ancient Chinese culture. Artificial eyes have also being found in Egyptian mummies. Ambroise pare (1510-1590)[2], describe fabrication of a nasal and an auricular prosthesis using gold, silver, paper and linen cloth glued together. Tychobrache (1546-1601) used an artificial nose made from gold to replace his own nose, which was lost in a duel.

1600 -1800

Pierre Fauchard (1678-1761)[2] made a silver mask to replace the lost portion of the mandible for a French soldier.The silver prosthesis was painted with oil paints, and the margins of the prosthesis were made inconspicuous by covering them with facial hair.

1800-1900

William Morton (1819-1868)[2] fabricate a nasal prosthesis using enameled porcelain to match the complexion of the patient.Claude martin (1889)[3]described using a ceramic material to fabricate a nasal prosthesis.

1900 -1940

Towards the end of 19th century vulcanite rubber was widely used.In 1913, gelatin–glycerin compounds were introduced in order to mimic the softness and flexibility of human skin.The life span of gelatin–glycerin compound was too short for practical clinical application.

1940-1960

Acrylic resin in1937, replaced the older vulcanized rubber. Acrylic resin became popular because oftranslucency, colorability and ease of processing.Tylman[2]introduced a resilient vinyl co-polymer acrylic resin to overcome the rigidity problem of acrylic resin.

1960-1970

Barnhart(1960)[2] was the first to use silicone rubber for constructing and coloring facial prosthesis by combining a silicone rubber base material with acrylic resin polymer strains.

1970-1990

Lontz[2] used modified polysiloxaneelastomers.Gonzalez[4]described the use of polyurethane elastomers.Udagama and Drane[8,9] introduced the use of Silastic Medical Adhesive Type A.

1990 to present

Antonucci and Stansbury[2]investigated newer acrylic resins.Gettleman[2] described using polyphosphazenesfor facial prosthesis.

MATERIALS CURRENTLY AVAILABLE

ACRYLIC RESIN

Acrylic resin occasionally used to make artificial facial parts. It can be successfully employed for specific types of facial defects, particularly those in which little movement occurs in the tissue bed during function (e.g. fabrication of orbital prostheses). It is easily available, easy to stain and color, has good strength to be fabricated with feather margin and a good life of about 2 years. Its rigidity and high thermal conductivity is a drawback.

ACRYLIC COPOLYMER

Acrylic copolymers are soft and elastic but have not received wide acceptance because of a number of objectionable properties like- poor edge strength,poor durability, subjected to degradation when exposed to sunlight, completed restoration often become tacky, predisposing to dust collection and staining,processing and coloration are difficult.[8]

POLYVINYL CHLORIDE AND COPOLYMERS

Vinyl polymers and copolymers a flexible plastic material is basically plasticized polyvinyl chloride or a copolymer of polyvinyl chloride & polyvinyl acetate. When resin fine granules are dispensed in a suitable plasticizing agent it results into a pliable, tough, life like material quite suitable for maxillofacial prostheses. However it had demerits like cured at high temperature in metal molds, due to plasticizer migration resulting in discoloration, and hardening of the prosthesis, particularly at the margins and often required reinforcement with nylon fibers. Serviceability was not more than 6 months.

Efforts have been made to improve polyvinyl chlorides by limiting the amount of plasticizer, hoping to minimize migration and loss at the margin of the prostheses. With these alterations, the lifespan of polyvinyl chloride prostheses has been extended to 9–11 months.[9]

The earliest form consisted of a combination of polyvinyl chloride (a hard, clear resin that is tasteless and odorless) & plasticizer. Recently, a copolymer of 5% to 20% vinyl acetate, with the remaining percentage being vinyl chloride introduced.This copolymer is more flexible but apparently less chemically resistant than polyvinyl chloride.

CHLORINATED POLYETHYLENE

Lewis and Castleberry (1980)[5]reported chlorinated polyethylene, similar to polyvinylchloride in both chemical composition and physical properties.Processing procedure involveshigh heat curing of pigmented sheets of the thermoplastic polymer in metal molds.Gettleman (1992) reported the evaluation of thermoplastic chlorinated polyethylene, as a potential maxillofacial material.Processing procedure involves steam autoclave with gypsum molds.

POLYURETHANE ELASTOMERS

Epithane 3 is available for use in facial restorations.These have excellent properties likeelasticity without compromised edge strength and hence allows thin material at the margins.Mobile tissue beds too can be restored with it.Cosmeticresults can be obtained, surpassing superior the other materials currently available

SILICONE ELASTOMERS

Since 1960, silicone elastomers have become the material of choice for maxillofacial prostheses because of the material's clinical inertness, strength,durability, ease of manipulation.Depending whether the vulcanizing process uses heat or not, silicones are available as:Room temperature vulcanized (RTV) andHeat vulcanized (HTV)

ROOM TEMPERATURE VULCANIZING SILICONE ELASTOMERS (RTV)

They are viscous silicone polymer including a filler, a stannous octate catalyst and an orthoalkyl silicate cross linking agent. Fillers are usually diatomaceous earth which improves strength.The type most commonly used, RTV Silicone Mdx 4-4210, has surface texture and hardness within the range of human skin. MDX4 - 421,0 - in a survey by Andres,[2] 41% of clinicians used this material for maxilla prosthesisfabrication. Moore[l3] reported that it exhibits improved qualities relative to

coloration and edgestrength. The material is not heavily filled, hence it is translucent. It exhibits adequate tensile strength, non-toxic, color stable and biologically compatible.Silastic 382, 399:- they are viscous silicone polymers which are color stable and biologically inert.

HEAT-TEMPERATURE VULCANIZING SILICONE ELASTOMERS (HTV)

This type of polymer requires more intense mechanical milling of the solid HTV stock elastomers compared with the soft putty RTV silicone, especially for incorporating the required catalyst for cross link. . Silastic 37O, 372, 373, 4 - 4574, 4 - 451,5 - they are usually white, opaque material with a highly viscous, putty like consistency. The catalytic agent is dichlorobenzoyl peroxide. They exhibit excellent thermal stability and are biologically inert but do not possess sufficient elasticity to function in movable tissue beds.Q7 -4635, Q7-4650, Q7 -4735, SE - 4524U-this new generation of HTV silicone evaluated byBell[12]which showed improved physical and mechanical properties compared to MDX4 - 421O andMDX4-4514 (RTV Silicone elastomers).

NEW MATERIALS

SILICONE BLOCK COPOLYMERS

Silicone block copolymers are new materials under development to improve on some of the weaknessesof silicone elastomers, such as a low tear strength, low elongation and the potential to support bacterialand fungal growth. They are more tear resistant than conventional cross-linked silicone polymers.In this blocks of polymers other than siloxane are positioned with the traditional siloxane polymers.

The hydrophobic nature and foreign nature of silicones have been proven to cause problems, especially with regard to the interaction with the body on a molecular level. This can lead to the induction of foreign body reactions and the development of infections particularly at the interface between silicone and tissue. These silicone block copolymers can to some extent overcome these problems as the more hydrophilic part of these amphiphilic polymers provide improved wettability and thus tissue compatibility. An example of this is the intertwining of polymethyl methacrylate into the chains of siloxane[10].

POLYPHOSPHAZENES

Polylphosphazene,fluoroelastomers have been developed for use as resilient denture liners and have the potential to be used as maxillofacial prosthetic materials[11].

ADHESIVES FOR FACIAL PROSTHESIS

A variety of adhesive systems has been employed to retain thefacial prosthesis in position. They are classified as (a) Pastes,(b) Liquids, (c) Emulsions, (d) Spray-ons, and (e) double sidedtapes with last one most common used (41%) among patientswith facial prosthesis because of its easy manipulation.An alternative to reduce the dependency on medical skinadhesives is the use of osseointegrated implants to retain thefacial prosthesis[13,14].

LIMITATIONS OF PRESENT MATERIALS

Romerdale E H stated that the prevailing prostheses materials have limitation like, they do not match the elastic modulus of skin, do not mimic the durometer properties of skin, the curing time is long, extrinsic tinting procedure is difficult, processing is done on a stone or metal cast. These materials are extremely sensitive to the presence of petroleum and amines.

MATERIALS OF THE THIRD MILLENNIUM

Romerdale E H also stated the materials of the third millennium are expected to be translucent, pigmentation ability to match any skin color, exceptional high elongation,should not tear under normal use, color stable, easily moldable with clay like consistency cured easily with light, gas or harmless spray chemicals, they should be adjusted with thinner from firm to very soft without loss of tear strength.

CONCLUSION

As there is an increasing demand for rehabilitation of maxillofacial defects due to the rise in the incidence of cancer each year, it should be noted that it is a psychological issue that impacts the social and functional life of people worldwide. From the overview it is deduced that the materials currently available still do not completely meet our needs.May be a dream but the possibility of fabricating high quality life like prosthesis

directly on the face or in mouth would require no more skill than a prosthodontist already has. If the dental material scientist can help us by providing a perfect material comprising of all the required properties of an ideal material of the third millennium to rehabilitate the patient with orofacial defect who deserves the best we can offer.

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