Outlook of magnesium alloy for rhinoplasty material

Jingming Li*

Si Chuan University,China

* Corresponding Author Email: lijingming_m@stu.scu.edu.cn

Abstract. Rhinoplasty is one of the famous cosmetic surgeries all over the world, as it not only benefits congenital nasal bone dysplasia patients, but also satisfy a part of people who want to look more beautiful and perfect. The materials commonly used in current rhinoplasty are prone to failure of rhinoplasty because of autologous absorption, loosening and slipping of nasal scaffold due to poor tissue compatibility, and difficulties in secondary repair[1-2]. Biodegradable magnesium alloy material is one of the most ideal biomedical materials with great application value. Mechanically, the biodegradable magnesium alloy material has good mechanical properties, similar to the mechanical properties of human bone; the density is similar to that of human bone. Biologically, degradable magnesium alloy material has the characteristics of excellent biocompatibility, biological activity, degradation products can be easily absorbed or excreted by human tissues; degradable magnesium alloy can induce cell differentiation growth and blood vessel growth[3]. This article analyzes the possibility of using degradable magnesium alloy material as a scaffold material for rhinoplasty and suggests that this porous nasal scaffold can be prepared by 3D printing method. By using this method, a restorative nasal plastic effect can be obtained by guiding the regrowth of autologous nasal bone tissue. From a long-term perspective, the surgical results achieved by using magnesium alloy as a scaffold material for rhinoplasty are what the medical aesthetic community has been seeking. The use of biodegradable magnesium alloy as a rhinoplasty material is a new approach that is feasible and has potential for future economic and social benefits, but this approach needs further research and experiments to be validated in the future.

Keywords: Rhinoplasty Materials; Intracorporeal Implant Metal Applications; Biodegradable Magnesium-based Alloys; Rhinoplasty Scaffolds; Rhinoplasty Methods.

1. Introduction

People can use medical treatments or operations to improve their appearances. Rhinoplasty is one of the famous cosmetic surgeries all over the world, as it not only benefits congenital nasal bone dysplasia patients, but also satisfy a part of people who want to look more beautiful and perfect. Not all materials can be used to apply this surgery. Different materials give out different effects and results. At present, the choice of rhinoplasty materials is diverse, but they all face the problems like being absorbed by body, causing infection and occurring displacement.

Magnesium based alloy matrix composite is one of the most potential degradable biomaterials implant in the 21 centuries. The density of Mg based alloy is very close to human bone density. Compared to other alloys, Mg based alloy has the closer elasticity modulus to human bone, which can effectively decrease the negative effects by stress shielding. Mg based alloy processes good cellular biocompatibility and biomechanical compatibility. It has osteoinductive activity and can promote bone healing. Most importantly, Mg based alloy can degrade in human body, and Mg is one of the essential elements for human. Mg can combine with phosphate to generate hydroxyapatite, which efficiently improve the bone healing process.

In this paper, I want to discuss whether the Mg based alloy can be used to make the prosthesis and apply in rhinoplasty surgeries. With advanced technology, the prosthesis can be got from easier and quicker ways like 3D printing method. And 3D printing will make the result of the nose surgery personalization and customization. Considering the advantages of Mg based alloy, it will induce the nose bone grow and Mg prosthesis will degrade until bone growing finishing. And finally, there is no extraneous materials in nose but the patient's nose is already better than before.

2. Current rhinoplasty materials

For our Chinese people, the characteristics of our nose are the back of the nose is low and flat, and the heavy person is saddle-nose deformity; thick skin on nose; the nose is round and blunt and hypertrophic; weak alar cartilage; nasal alar base wide; the nasal columella is short; the nasolabial Angle is sharp; the nostrils are usually ovoid in shape[4].

To find proper prosthesis, we should focus on the three base requirements. First, pay attention to biocompatibility, the materials chosen should do not harm the human body and can provide bio function. Also we should consider tissue integrability and aging resistance. Second is aesthetics, the materials do not change the color of the nose skin, displacement won't happen after implanting and will not cause hyperplasia. Third one is matched mechanical property; the materials should have close elasticity modulus and compression/tension stress to human bone.

Current rhinoplasty materials include autogenous cartilage, silicone, polytetrafluoroethylene (PTFE) and hydroxyapatite. Their advantages and disadvantages are shown in Table 1.

Table 1. Advantages and disadvantages of various rhinoplasty materials[1-2,4-6]

Materials	Advantages	Disadvantages
Autologous Cartilage	No rejection; Good histocompatibility; Soft and good carving	Easily absorbed; wound from taking cartilage; surgery lasts a long time
Silica Gel	good antibacterial stickiness; as soft as real autologous nose; not easy to deform	Smooth surface; easily move or incline in the nose
PTFE	Good histocompatibility due to porous; stable; displacement won't happen; autologous tissues and blood vessels can grow in	Poor resistance of infection; difficulty to removal and repair if the prosthesis should be taken out
Sodium Hyaluronate	Non-toxic; high safety	Easily absorbed; short maintenance time of rhinoplasty effect
Hydroxyapatite	Good biocompatibility; bone guidance; often used as a coating material for various bone scaffolds	Poor plasticity; easy to wear and produce particles, and the resulting particles can seriously affect wound recovery and lead to wound inflammation

2.1. Autologous cartilage

It's obviously that autologous cartilage is the most suitable materials to use in rhinoplasty surgery. Cartilage that always used contains ear cartilage, costal cartilage and septal cartilage. However, for Asians, there is often an underdevelopment of nasal septum cartilage. And the autologous septum cartilage cannot be supplied in sufficient quantities[4].

For ear cartilage, doctors always use it to elevate the height of the nasal tip and change the curvature of the nasal tip. It is always applied with artificial prosthesis. For cost cartilage, it not only can be used to perfect nasal tip, but also can be used to do nasal bridge filler[2].
Autologous cartilage is very comfortable after implanting. It hardly cause rejection and infection reaction in clinical practice. But the biggest problem is that it is easy to be absorb by body, which will lead the surgery result fall flat[1].

2.2. Silica gel

The surface of silica gel is smooth. 10 years ago, silica gel is the most famous prosthesis used in medical cosmetology industry. It is because of good antibacterial stickiness and as soft as real autologous nose. Silica gel prosthesis itself is not easy to deform. After taking out the silicone prosthesis implanted in the body for more than ten years in clinical practice, the shape of the prosthesis remains the same, and the carving marks of the last operation are still clearly discernable[1].

2.3. Expanded polytetrafluoroethylene (PTFE)

This kind of material is porous, so tissue can grow into it. Expanded polytetrafluoroethylene is stable, prosthesis made by it does not occur displacement. It has poor resistance of infection because it attach nasal tissue. The exposure rate of expanded rhinoplasty is lower than that of silicone prosthesis. The expanded polytetrafluoroethylene (PTFE) has an ultra-microporous structure of 30-50μm on its surface, which allows it to bind with autologous tissue and blood vessels can grow in. After autologous tissues and blood vessels grow in, they can carry white blood cells such as neutrophils and macrophages to fight infection. The blocking of micropores also plays a role in avoiding bacterial colonization. However, this advantage also brings the difficulty to removal and repair if the prosthesis should be taken out[1].

2.4. Sodium hyaluronate & Hydroxyapatite

Sodium hyaluronate is a material that can be absorbed by the human body, and its use as a rhinoplasty material maintains the effect of rhinoplasty for a short period of time. Sodium hyaluronate is non-toxic and can be absorbed by human body, so it is safe[2].

Hydroxyapatite granules are a new type of rhinoplasty material, consisting of two parts, hydroxy and apatite, in granular form, with good bio-histocompatibility and also bone guidance ability. However, its plasticity is poor and it tends to wear away to produce particles. The hydroxyapatite particles produced can seriously affect wound recovery and lead to wound inflammation. Hydroxyapatite is often used as a coating material for various types of bone scaffolds[2].

3. Metal implants in human body

There are a variety of metallic materials currently used for implantation in the human body as the Table 2 shows, which are usually stable, non-degradable and have excellent mechanical properties. In recent years, researchers have worked to invent a variety of degradable materials, and in addition to non-metals, degradable metal-based materials have emerged.

Table 2. Application of metal implants in human body and their advantages and disadvantages[3,7-9]

Materials	Advantages	Applications	Disadvantages
Titanium Alloy	Good biocompatibility; Highly stable in vivo; Non-toxic; Light weight; High strength; Density similar to human bone; Implanted titanium alloy can still do magnetic resonance imaging (MRI)	Artificial joints; Dental implants; Bone splints; Plate nails; Scalpels	Non-degradability; High modulus of elasticity leading to stress shielding
Stainless Steel	Good biocompatibility; Low cost; High processability; Good mechanical properties; Strong corrosion resistance	Dentistry implants; Fracture internal fixation devices; Artificial joints	Cannot do MRI after implantation of stainless steel; Metal allergy to elemental nickel may occur
Bioceramic	Excellent biocompatibility; Chemically reacts with bone; Stable binding; Non-toxic; Non-side effects; Non-irritating; Non-sensitizing; Non-carcinogenic	Artificial total hip, knee, shoulder, elbow, wrist; Bone plate; Bone screw; Bone metal wire; Artificial tooth root replacement implant	Low strength; High brittleness; Low flexural strength; Poor toughness and mechanical properties; Easy to wear and produce particles
Degradable Magnesium Alloy	Excellent biocompatibility; Biologically active, it can induce cell differentiation and vascular growth; Matches human bone mechanics; Close to human bone density; Degradation products are easily absorbed by human or excreted from the body	Coronary artery stents; Bone screws; Materials for bone plant devices with great application potential; Materials in the field of vascular stents	Too fast degradation rate; Accumulation of degradation products

3.1. Titanium alloy material

Titanium alloy is commonly used for human implants such as artificial joints, dental implants, bone grafting plates and plate nails. It is a non-degradable human implant material. The density of titanium is similar to that of human bone, and it is lightweight.

Pure titanium is biocompatible and has a strength of 390-490 MPa. Pure titanium has the advantages of non-toxicity, light weight, high strength and good biocompatibility. Experiments have

shown that titanium has superior fatigue and corrosion resistance compared to cobalt-based alloys and stainless steel. Titanium has good surface activity and slight tissue reaction, which can easily react with oxygen to build a dense oxide film. Therefore, titanium and titanium alloys have the conditions of biomedical materials, is a more ideal, suitable for implants, promising implant materials[6]. However, it is worth noting that the elastic modulus of titanium alloys is higher than that of human bone. So stress shielding can occur when they are used as orthopedic implants, leading to resorption of the autologous bone and eventual implant failure.

3.2. Stainless steel material

Medical stainless steel has a low cost and good processing properties, mechanical properties. And is now widely used in dentistry and fracture internal fixation devices, artificial joints and other fields. At this stage, medical stainless steel is still the most widely used medical metal materials. Surgical stainless steel implant material mechanical properties are very good, yield strength in about 500MPa, tensile strength in about 900MPa, and mechanical properties can be adjusted, is the ideal permanent surgical implants and bone suture devices. Medical stainless steel used in the human body, there are biocompatibility and other related issues, which involves the stainless steel implanted in the body will be corroded or wear metal ion leaching, which will cause human tissue reactions, especially nickel ion precipitation in stainless steel will induce serious lesions. Clinically, 316L stainless steel implanted in the human body, in the physiological environment, sometimes produce crevice corrosion or friction corrosion and fatigue corrosion rupture, but also due to friction and wear and other reasons to release Ni^{2+}, Cr^{3+} and Cr^{5+}, making the prosthesis loose, and ultimately lead to implant failure. Sometimes the corrosion resistance of stainless steel in salt water can be enhanced by adding molybdenum, but stainless-steel medical instruments implanted with a certain percentage of nickel may have metal allergy problems when they come into contact with human tissue.

3.3. Bioceramic materials

The composition of bioceramic materials is mainly hydroxyapatite. Bioceramic materials have the characteristics of both stainless steel and plastic materials, but also have good hydrophilicity, which can maintain good affinity with biological tissues and cells in living organisms.

Currently, bioceramic materials are mainly used in human hard tissue repair and reconstruction. Hydroxyapatite bioceramic material has obvious advantages in replacing bone. It is not only biocompatible and conductive, but also chemically reacts with human and animal bones, and is non-toxic, non-irritating, non-allergenic, non-carcinogenic, and non-mutagenic, making it the most ideal material for filling bone defects[8].

The hydroxyapatite bioceramic material has good biocompatibility and can be tightly bonded to bone in human and animal bodies. The hydroxyapatite bioceramic material is partially dissolved by the action of body fluids and is absorbed and used by the body to grow new tissues for internal conduction of the bone. In addition, hydroxyapatite bioceramic materials have strong adsorption capacity, good bioactivity, large surface area and high solubility, which are of great potential value in many fields[8]. However, the low strength, high brittleness, low flexural strength, poor toughness and mechanical properties of bioceramic materials affect its wide application in medical clinics alone. Therefore, they are usually used as coating materials or combined with other materials, thereby obtaining biomedical composites with excellent mechanical properties and good bioactivity.

3.4. Degradable magnesium alloy material

Magnesium alloy has good biocompatibility, in vivo degradability and excellent physical and mechanical properties, which can effectively avoid the harmful ion leaching, long-term rejection and stress masking effects brought by inert metal materials after implantation. It can also solve the problems of low strength of biodegradable polymer materials and high brittleness of bioactive ceramic materials. Degradable magnesium alloy is one of the most ideal biomedical materials with great potential for application in the field of bone plant devices and vascular scaffolds[9].

In the field of orthopedics, magnesium alloy materials match the mechanical properties of human bone and can effectively reduce the stress masking effect. The density of magnesium and magnesium alloy is similar to that of human bone, and the magnesium ions generated by the degradation of magnesium are easily absorbed by human tissues or excreted through body fluids, and its biodegradability avoids the pain of secondary surgery for patients and has good biocompatibility.

Porous magnesium alloy material as a biodegradable biomaterial can provide space for cells to grow in three dimensions and facilitate the exchange and transport of nutrients and metabolites. Magnesium itself is biologically active and can induce differentiated cell growth and vascular growth into it. During the process of material degradation and absorption, the implanted cells will continue to proliferate and grow, which is expected to form new corresponding tissues and organs with original specific functions and morphology for the purpose of repairing wounds and reconstructing functions. The complete degradability and outstanding biocompatibility of biodegradable magnesium alloy materials for biomedical use are expected to be widely used in clinical hard tissue repair or replacement[6].

Magnesium-based alloys are currently being used significantly in the cardiovascular field. Their mechanical properties and corrosion kinetics are well controlled under physiological conditions, and they achieve the purpose of vasodilatation while overcoming the complications caused by the long-term retention of the implant[6]. In orthopedic applications, magnesium alloys cannot meet the requirements of bone mechanics in human weight-bearing areas and using them as bone scaffold implants can cause secondary fractures or bone fractures and aggravate the patient's condition, but biodegradable magnesium alloys can be used for bone repair in non-weight-bearing areas. And the degradation of magnesium alloy in vivo is fast, if the degradation rate is faster than the recovery rate of human tissue, it cannot play its biological role. When the degradation products accumulate in large quantities around the tissue, it may affect the recovery process of the tissues.

In summary, after comparing the four human implant materials, it is easy to find that magnesium-based alloy has the advantages of good biocompatibility, bio-inductivity, non-toxicity, high elastic modulus and adjustable mechanical properties, and is one of the ideal new biodegradable materials for human implantation.

4. Validation of biocompatibility and degradation rate of magnesium alloy

In order to verify the in vivo compatibility of magnesium alloy, Wang et al. (2016) used MC3T3-E1 cells (MC3T3-E1 cells are a mouse preosteoblast cell line) to co-culture with pure magnesium and AZ31 magnesium alloy scaffold, and the number of cells adhering to the surface of magnesium alloy porous scaffold after 24 h of culture was significantly higher than those adhering to the surface of pure magnesium porous scaffold, the results are shown in Figure 1; the 21-day mineralization results showed that the number of mineralized nodules in the magnesium alloy porous scaffold group was more and the area was larger, indicating that the magnesium alloy stent could promote the formation of osteoblastic mineralized nodules, the results are shown in Figure 2. The experiments showed that the magnesium alloy scaffold can promote the adhesion, proliferation and mineralization function of osteoblasts, which has good biological function. The appropriate magnesium ion concentration can lead to cell activation by regulating protein synthesis and its auxiliary processes. At the same time, calcium ions deposited on the surface of magnesium alloy scaffolds can co-promote osteoblast proliferation[10].

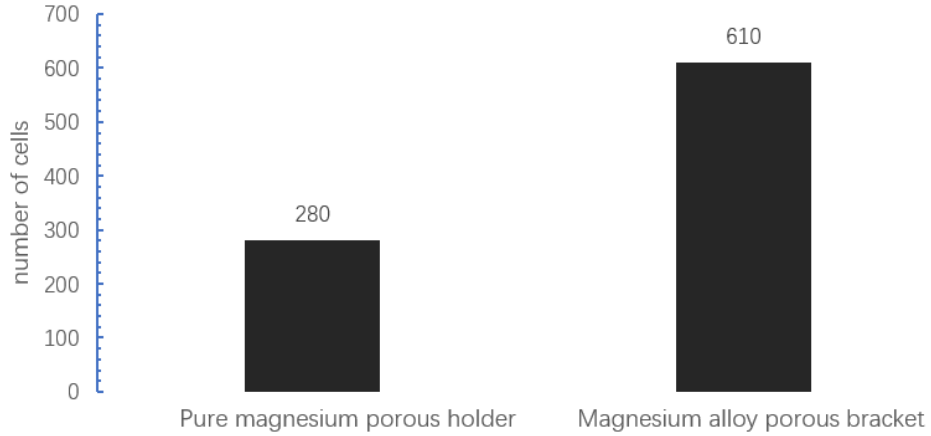


Figure 1. Number of osteoblasts in mice on scaffolds after 24 hours[10]

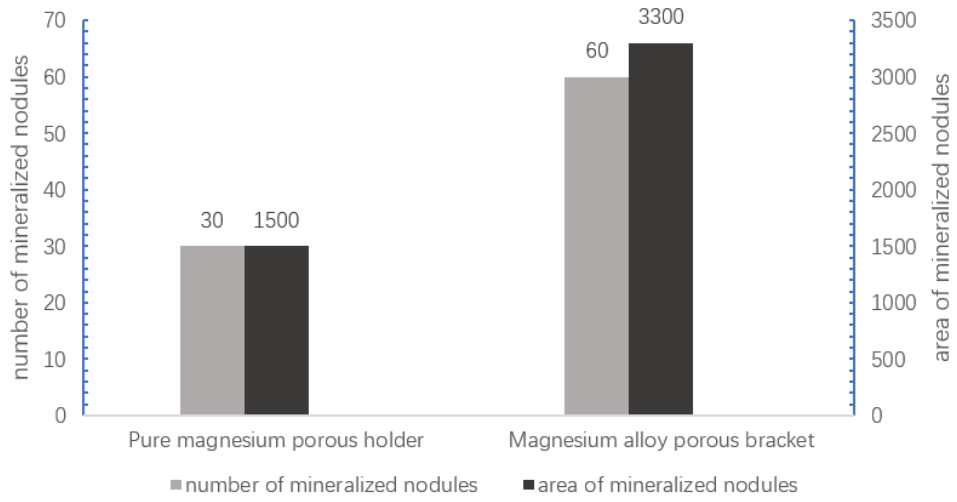


Figure 2. Number and area of mineralized nodules on the surface of the stent after 21 days[10]

For this point, Li (2019) also conducted experiments through mouse embryonic osteoblasts, using materials including pure magnesium, Mg-0.3Ca porous magnesium, Mg-6Zn-0.3Ca porous magnesium and fluorinated porous magnesium. Through the experimental results, it was found that the corrosion resistance of the fluorinated porous magnesium was significantly improved and showed good bioactivity; the pH of the porous magnesium extract was high and showed low cytotoxicity over a long time range, and osteoblasts could not spread and grow on the scaffold surface when the pH was too high; by virtue of the higher surface roughness, the inner and outer surfaces of porous magnesium were favorable for cell adhesion and showed good osteoconductivity[11].

Gu et al. (2008) and Dong et al. (2018) conducted separate experiments on magnesium-strontium alloys. Gu chose to implant magnesium-strontium alloys into mouse femurs, and after four weeks the alloys showed signs of degradation and the new bone density was significantly higher than that of the blank control dwelling. Although there was localized surface corrosion of the alloy, the intact morphology was largely maintained. The newly formed bone was in good contact with the alloy surface[12]. Dong chose to implant the magnesium-strontium alloy into rabbits, and the results after eight weeks of implantation demonstrated its biocompatibility and potential as an orthopedic implant material[13].

By summarizing and comparing the above experimental results, it is easy to find that magnesium alloy has good biocompatibility and biofunctionality, magnesium alloy can promote the adhesion of osteoblasts to magnesium alloy material and promote cell proliferation; the cytotoxicity of magnesium alloy is related to the degradation rate; magnesium alloy has certain osteoinductivity and the newborn bone has good contact with the surface of magnesium alloy material.

In order to verify the degradation rate of magnesium alloy, Wang et al. (2021) performed a tibial magnesium alloy bone splice experiment on New Zealand rabbits. The results showed that after 8 weeks of implantation in New Zealand rabbits, a layer of grayish-white corrosion products was formed on the surface of the bone plate. Energy spectrometer analysis showed that the corrosion products formed on the surface of the magnesium alloy bone plate mainly consisted of oxygen, carbon, nitrogen, magnesium and phosphorus elements. After removing the corrosion products on the surface of the magnesium alloy bone plate, clear corrosion pits can be seen, the corrosion pits are small in size and evenly distributed, and the surface corrosion is uniform. After 4, 8 and 16 weeks of implantation, aggregate the results and plot them as Figure 3. It was found that the degradation of the magnesium alloy bone plate gradually deepened with the prolongation of the implantation time in vivo. The bending stiffness and bending strength of the magnesium alloy bone plate gradually decreased with the deepening of the degradation process[14].

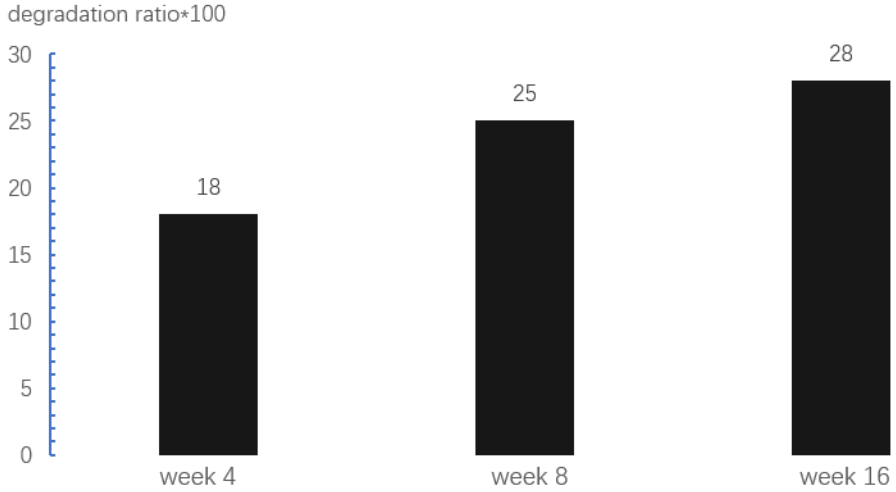


Figure 3. Degradation rates of magnesium alloy bone plates in New Zealand rabbits after 4, 8 and 16 weeks[14]

With this, Yang et al. (2017) investigated the degradation time of magnesium alloy by implanting magnesium alloy in the infrarenal abdominal aorta in New Zealand rabbits, and the implant material used was a magnesium alloy wire of 15 mm length and 3 mm diameter. The degradable magnesium stent filaments completed basic degradation in the rabbit abdominal aorta in 4 months, and the degradation products were mainly calcium and phosphorus components with good biosafety. 1 month when the stent was clear and intact, the continuity was good, and with the extension of the follow-up time the stent gradually degraded, the morphology changed, and the original integrity of the stent filaments was lost. The in vivo degradation of magnesium stents is mainly the process of replacing magnesium elements with calcium and phosphorus[15].

Niu et al. (2017) conducted experiments by making a rabbit mandibular fracture model with degradable medical magnesium alloy screws (which is called JDBM-DCPD) for internal fixation. After 18 months of implantation, only a small middle portion of the screw remained undegraded. At the same time, significant new bone tissue could be observed around the screw, indicating its significant bone-enhancing effect. After 18 months of implantation, the screw lost its original shape and the remaining volume was only about 10.7% of the original volume. Since the shape of the screw remained largely intact after 4 months of implantation, the JDBM-DCPD screw was considered to have a supportive function in the rabbit mandible for at least 4 months[16-17].

Kong et al. (2014) used biodegradable medical magnesium alloy (JDBM) and biodegradable medical magnesium alloy screws (JDBM-DCPD) for internal fixation by making a goat fracture model, and polylactic acid (PLA) screws were used as a control group. CT scan results showed that the degradation rate of JDBM-DCPD screws was significantly lower than that of JDBM. JDBM-DCPD group did not observe significant bubble focus at 1 month, 3 months, and 6 months after

implantation, which significantly promoted fracture healing. both the JDBM and JDBM-DCPD groups showed good bone-enabling effects, and the JDBM-DCPD group had more new bone tissue. Follow-up studies also showed that the JDBM group had higher levels of osteogenic factors around the implant compared to the PLA group[18].

Through their extensive experimental results, we can find that magnesium alloy can be completely degraded in vivo, and the degradation products are mainly calcium, phosphorus and other components, which are safe and harmless to human body in a certain concentration range and have good biosafety; the mechanical behavior of magnesium alloy decreases with the degradation of the material, and the support function of the material can be controlled by regulating the degradation rate of the material, which also helps and promotes the fracture healing.

5. Discussion about magnesium alloy and rhinoplasty implants

Magnesium alloys have the advantages of being non-toxic to humans, biocompatible and functional, degradable and metabolizable in vivo, as well as good mechanical properties and modifiable mechanical behavior. Most importantly, magnesium alloys are osteoinductive and can guide the growth and differentiation of osteoblasts on the material to form new autologous skeletal tissue. If magnesium alloys are implanted in non-weight-bearing areas, the occurrence of mechanical defects can be avoided and, combined with the advantages of magnesium alloys, the regeneration of bone tissue can be re-induced. Here, the hypothesis of using magnesium alloy as a scaffold for rhinoplasty implants can be proposed. The alloy is partially attached to the autologous nasal bone tissue and the osteoinductive properties of magnesium alloy are used to induce osteoblasts to climb onto the scaffold and grow and differentiate only within the volume of the scaffold. During the process of bone growth, the scaffold is degraded at the same time, achieving a rhinoplasty effect without any external material implantation, and achieving an ideal nasal restoration.

The magnesium alloy nasal scaffold can be prepared by 3D printing method. The patient's nasal bones are scanned and modeled in 3D, and a customized nasal scaffold is designed for each patient's nasal condition to quickly simulate the postoperative result. Compared to conventional methods, traditional nasal scaffold prostheses, such as autologous cartilage, require sculpting and finishing by the surgeon after removal of the cartilage, which makes it impossible to predict the postoperative outcome and the surgeon's subjective aesthetics has a significant impact on the surgical outcome. 3D printing can prepare the required nasal scaffold in advance, eliminating the need for on-site fabrication of the scaffold during surgery, significantly shortening the surgical time and avoiding the impact of subjective factors on the surgical outcome.

The biggest advantage of this method is that the material selected for rhinoplasty can induce autologous bone growth, achieving a perfect restorative nose reshaping. In the case of silicone implants, because the cells cannot be attached, it is easy to cause the sequelae of spasm and contraction of the nasal membrane, and in serious cases, the nose needs to be repaired twice; in the case of autologous cartilage implants, the material used is taken from the body so it is easier to be absorbed by the body, and the absorption of the rhinoplasty material not only affects the plastic surgery results, but serious absorption problems can cause the nose to return to the state before plastic surgery, resulting in the failure of rhinoplasty. The method of using magnesium-based alloy nasal scaffold can avoid both of the most common sequelae and failures mentioned above and achieve guided regrowth of the autologous nasal bone. The newly grown nasal bone tissue will not be resorbed by the autogenous body weight, and because of the new tissue growth the nasal membrane will not shrink, leading to the need for secondary repair.

For the envisioned nasal scaffold prosthesis, it is initially expected that a porous structure could be used. The porous structure can help blood vessels to grow in and cells to climb; it can enhance the mechanical properties of the stent and ensure the stability of the stent; it can increase the surface area ratio of the stent and accelerate the rate of cell growth and degradation of the stent.

6. Conclusion and Outlook

Magnesium alloy has many advantages compared with ordinary rhinoplasty materials and ordinary implant materials. Not only can it avoid the disadvantages of ordinary rhinoplasty implants that may be displaced and sliding in the nose, spasm of nasal membrane, and failure of rhinoplasty due to autologous resorption, but it also allows the final rhinoplasty effect to be provided by autologous new bone tissue by inducing the growth and differentiation of bone cells on the rhinoplasty scaffold, achieving the ideal real native effect of rhinoplasty without the implantation of nasal scaffold.

The use of magnesium alloy as a rhinoplasty material is a logical and theoretically based idea. However, there are some questions that need further research and experiments, whether the implanted nasal scaffold will have an effect on the autologous nasal function, how to regulate the balance between the degradation rate and the cell growth rate, whether the cells will grow according to the scaffold as it is after implantation without overgrowth, and whether the plastic result of the newly grown nasal bone is better than that of the plastic result with prosthesis. These questions can only be answered from experiments, and I hope to have the opportunity to experiment with this idea sometime in the future. If all of them can be answered satisfactorily, the use of magnesium alloy material as a rhinoplasty prosthesis support will become a new rhinoplasty option under cost-controllable conditions.

In the long term, the use of magnesium alloy as a scaffold material for rhinoplasty is a new approach that is feasible and has potential for future economic and social benefits.

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