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# Anophthalmic Socket

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**Abstract**

Anophthalmos is defined as an orbit without a clinically detectable eye. This condition can be either congenital or acquired. Congenital anophthalmos is a different entity and rare (prevalence 0.2 – 0.3/10,000), and will not be covered in this section. Acquired anophthalmos is much more common and can occur after trauma, but is usually caused by surgical enucleation. Indications for enucleation include malignant intraorbital tumours, painful blind eyes, and phthisical or buphthalmic eyes, which cannot be improved otherwise.

Acquired anophthalmos can be complicated by the clinical features of a post-enucleation socket syndrome (PESS). This unpleasant condition is defined by a combination of an enophthalmos of the artificial eye, upper sulcus deformity, lower lid sagging, upper eyelid malposition and tilting of the prosthesis. In cases of soft tissue and conjunctival shrinkage, a 'contracted socket' can develop. This severe condition makes fitting and wearing an artificial eye difficult or even impossible. Current concepts for the prevention and therapy of PESS and a contracted socket are presented. This includes the insertion of primary and secondary orbital implants (which can either be alloplastic or autologous), the use of mucous membrane grafts and different steps of lid surgery. Volume replacement via orbital implants is mandatory for the prevention of PESS. Currently, simple spheres are in use, which can be either solid or porous. Alternatively, an autologous dermofat graft can be used. This transplant, consisting of de-epithelialized skin (dermis) with adjacent fatty tissue, is preferably harvested from the gluteal area and transferred into the socket, where it is attached to the orbital soft tissue components. It can be used both as a primary and a secondary orbital implant. The latter combines volume replacement with increased conjunctival lining, which makes it advantageous for the treatment of a contracted socket. In addition, extensive mucous membrane grafting to the fornices can improve prosthesis fitting. Finally, lid malpositions such as upper and lower eyelid entropion, lower lid laxity or acquired ptosis can be corrected by means of classical eyelid procedures, including Jones entropion repair, a lateral tarsal sling procedure or anterior levator resection ptosis repair. However, for good aesthetic and functional results, close cooperation with the ocularist is mandatory.



The term 'anophthalmic socket' is usually defined as an orbit not containing an eyeball, but with orbital soft tissues and eyelid structures. This condition is rarely congenital but usually is acquired. The most common cause of an anophthalmic socket is

an enucleation of the globe. The purpose of this chapter is to familiarise the reader with the problems associated with an anophthalmic socket and to introduce current concepts of their surgical management.

## Post-Enucleation Socket Syndrome

Sequelae of an enucleation are orbital volume deficiency and changes in the orbital soft tissue architecture leading to the clinical picture of 'post-enucleation socket syndrome (PESS)'. This term was introduced by Tyers and Collin [1]. The clinical features of PESS compromise an enophthalmos of the artificial eye, a deep upper eyelid sulcus, lower lid laxity and eyelid malpositions such as ptosis or lid retraction. Smit et al. [2] then added the feature of a tilting of the prosthesis associated with an anterior-to-posterior and superior-to-inferior rotation of orbital tissues. This reallocation of orbital soft tissues in combination with a lack of eyeball volume – and not orbital fat atrophy – is responsible for the development of PESS [3]. This undesirable condition can be prevented best by the primary insertion of an adequate and safe orbital implant.

## Contracted Socket

A contracted socket is defined as the shrinkage and/or shortening of (soft) tissue lining in the anophthalmic orbit, which makes the fitting of a satisfactory cosmetic prosthesis impossible [4]. Pathophysiologically, this is a consequence of conjunctival and subconjunctival scar formation involving fibroblasts and their contraction after wound healing or inflammation. Causes can be mechanical and surgical trauma, thermal and chemical burn, irradiation and – probably most commonly – chronic inflammation. The latter is mainly due to prosthesis problems with poorly fitted, too large and not well-maintained artificial eyes with rough surfaces and sharp edges. At early stages, therefore, it is promising to administer conservative treatment using lubricants, anti-inflammatory therapy (i.e. topical steroids), and prosthesis modification or polish.

## Clinical Features

With PESS, patients often suffer from an undesirable appearance with an enophthalmos of the artificial eye, a deep upper eyelid sulcus (which can be very marked), lower eyelid laxity and eyelid malpositions such as ptosis or lid retraction. However, a prosthesis can always be fitted and worn without spontaneous loss. This might be different in contracted sockets with varying degrees of severity. Mild socket contraction is associated with lagophthalmos, entropion and lower eyelid retraction due to



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the contraction of the conjunctiva, and underlying orbital connective soft tissue compartments causing shallow fornices, where an artificial eye still can be retained. More advanced cases show a loss of fornices, provoking spontaneous losing of the artificial eye, and severely contracted sockets with a complete loss of the conjunctival lining and the formation of symblephara or even ankyloblepharon. This makes wearing an artificial eye impossible. Often secretion and chronic discharge is associated. Features of both conditions – PESS and a contracted socket – often co-occur in any combination.

## Indications and Goal of Surgery

The aim of socket surgery in anophthalmic patients is to minimise this disfigurement, either related to volume or lining deficiency in the socket. In consideration of the significant psychological strain of patients showing features of PESS due to an unsatisfactory and unsightly appearance, any primary surgery for eyeball removal plays a crucial role. Choosing the optimal surgical procedure with the best and safest orbital implant available can prevent the patient from wasting long hours on unsuccessful prosthesis fitting and life-long suffering.

## Principles of Surgery

In the presence of PESS – optimal prosthesis fitting provided, ideally in close cooperation with the ocularist – the patient can be offered a range of surgical interventions in order to maximise the wearing comfort of the artificial eye and to minimise discomfort and disfigurement. Depending on the patients' clinical features and his appearance, complaints and ambitions, different shortcomings can be addressed. This includes orbital volume deficiency, eyelid malpositions like lid laxity, entropion, ptosis or retraction, and socket contraction. More than one procedure is often necessary to improve or even solve the problem. In order to obtain the best possible best result with minimum effort, it might then be mandatory to maintain a certain sequence of the procedures. However, surgical rehabilitation in severe cases of the volume deficiency or socket contraction can be very challenging for both the patient and the surgeon.

Socket surgery includes a variety of surgical procedures, which are mainly implemented to either substitute orbital volume or augment socket conjunctival lining. This includes the replacement of orbital volume by insertion of secondary orbital implants, which can be both alloplastic or autologous. Alloplastic implant volume is stable; however, with any aggressive dissection and increased intraorbital pressure, existing orbital soft tissue, i.e. orbital fat, might be damaged, resulting in fat atrophy. Alternatively, instead of using alloplastic orbital implants,



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autologous dermis-fat grafting can be considered. Any residual volume deficit might then be corrected with an orbital floor implant, if necessary combined with fornix-deepening procedures. Finally, in rare cases a dermis-fat graft can be placed in the superior sulcus. Lately, fillers have been used to augment orbital volume [5–7].

In severely contracted sockets, mucous membrane grafting into the fornices will reconstitute socket architecture and improve prosthesis fitting. Finally, lid malpositions like upper and lower eyelid entropion, lower eyelid laxity, or acquired ptosis can be corrected by means of classical eyelid procedures, including Jones entropion repair, lateral tarsal sling procedure and anterior levator resection ptosis repair. Eventually an upper lid blepharoplasty on the contralateral eyelid is helpful to camouflage some asymmetry. However, for good aesthetic and functional results, close cooperation with the ocularist is not only desirable but mandatory.

## Preoperative Assessment

Before any surgical correction, it is obligatory to evaluate the patient's concerns. What bothers the patient most? Is it pain and discomfort? Is it mainly the appearance, or does he even suffer from a spontaneous loss of the artificial eye? Is it a long ongoing history? For the medical history, matters of interest are previous surgeries, orbital implants, irradiation and fittings of an artificial eye. During the clinical examination, the following aspects are assessed: overall impression, the position and stability of the artificial eye (spontaneous loss?), and whether the patient is able to wear a prosthesis at all. On gross examination and slit lamp exam, one should look for an enophthalmos of the prosthesis and the configuration and depth of the upper eyelid sulcus. Inside the socket, it is of interest to examine the fundus and the fornices, the type of lining (conjunctiva, mucous membrane, skin?), and whether conjunctival/subconjunctival scars or symblephara are detectable. Is there a volume deficit? Is an orbital implant palpable? The situation of the eyelids should be respected. Do they close properly, or are lagophthalmos and retraction present? Is there any horizontal laxity detectable, and how is the eyelid margin configured? Finally, the condition of the artificial eye should be examined. This includes size and configuration, the surface with possible deposits, and the edges of the prosthesis.

## Volume Augmentation: Surgical Principles

In patients with classical PESS with volume deficiency only, volume replacement is the first measure. Such volume augmentation is promising when the soft tissue components in the socket are still soft and malleable and not constricted due to significant fibrosis. Pushing the orbital content backwards into the socket with a finger pressing



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onto the lower eyelid can easily check this: if the upper sulcus is then filled by existing orbital fat and bulging anteriorly, an alloplastic orbital implant will have a good chance to improve the problem.

If no orbital implant is present, secondary implantation using alloplastic implants or autologous transplants are in use. However, extensive dissection in the deep orbital soft tissues in order to locate and visualise the extraocular muscles should be avoided. This usually causes tissue alteration and persistent damage. It has been shown that repeated and extensive surgical dissection will cause a significant shrinkage of orbital fat tissue with a loss of orbital volume, undoing any volume augmentation initially intended [3]. For this reason it is advisable to avoid any gratuitous dissection in the soft tissue planes of the orbit, including the exposure of the extraocular muscles. An alloplastic implant should be positioned intraconally in the depth of the orbit, possibly behind the remnants of the posterior Tenon's capsule.

*Secondary Alloplastic Orbital Implant Insertion: Technique*

Before the surgery, which usually is performed under general anaesthesia, the motility in the socket without an artificial eye is checked during slit lamp examination. The virtual sagittal axis, along which the anterior surface of the socket is moving, is marked on the conjunctival surface with a marker pen. Then, at the beginning of the surgery, the conjunctiva is opened horizontally at this mark. Scar tissue, if present, is dissected and excised. This is followed by mainly blunt dissection into the depth of the orbit to create a space to accommodate the orbital implant. This should be performed in a possibly atraumatic manner to avoid damage to the soft tissues and bleeding, with only minimal use of cauterisation. A solid or porous orbital implant – according the preferences of the surgeon – may be wrapped with donor sclera or Vicryl™ mesh. The size of the implant depends on the amount of volume deficiency and the space available, and the spheres may differ from 18- to 22-mm spheres. However, undue pressure in the socket caused by an implant that is too large increases the risk of extrusion. It can be helpful to use a sizer. Also the correct insertion technique of the secondary orbital implant is mandatory to prevent later exposure. To avoid gradual tissue restitution after forced ball implantation ('cactus syndrome') as described by Sagoo and Rose [8], a polythene glide can be used – comparable to an injector in intraocular lens implantation. The best position for the implant is deep into the apex of the orbit, behind the posterior Tenon's capsule.

If available, the rectus muscles are sutured with 6-0 polyglycolic acid sutures onto the wrapping material or the porous implant anterior surface; however, usually any healthy looking subconjunctival tissue in the 12-, 3-, 6- and 9-o'clock position is taken. Undue tension should be avoided. Tenon's capsule and conjunctiva are closed in two layers without tension, using single-stitch sutures. Finally, a conformer is inserted into the conjunctival sac.

Closure of Tenon's capsule over a baseball implant may result in shortened fornices exacerbating a pre-existent mild form of socket contraction. To avoid this, the con-



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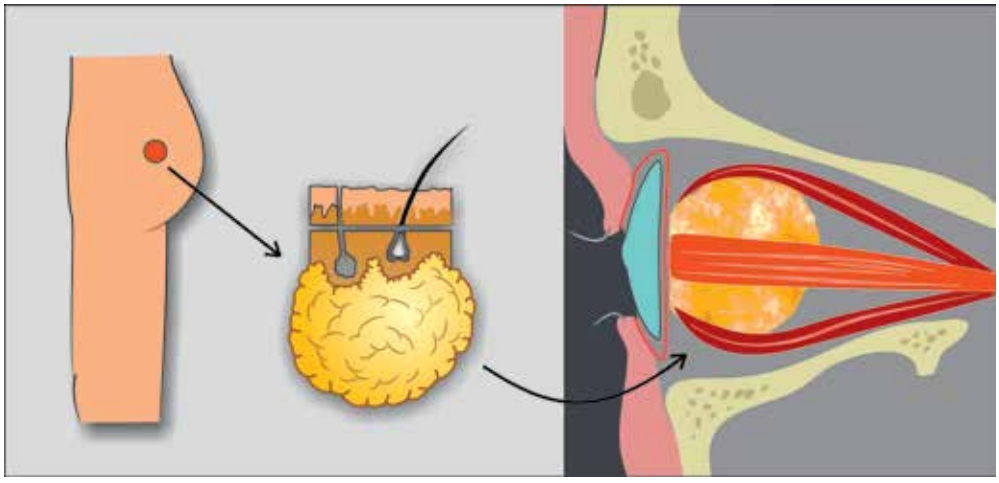

**Fig. 1.** Principle of dermofat grafting.

junctiva can be dissected into the fornices. In cases with shallow fornices, however, baseball implantation should be avoided and secondary dermis-fat grafting be preferred as a safe alternative [9].

## Dermis-Fat Grafting: Surgical Principles

A dermis-fat graft consists of de-epithelialised skin (dermis) with adjacent fatty tissue, preferably harvested from the gluteal area. It is transplanted into the socket, where it is attached to the orbital soft tissue components (fig. 1). If it is used as a secondary orbital implant, it does combine volume replacement with conjunctival lining augmentation, as the recipient conjunctiva can be attached to the very edge of the dermis-fat graft. This makes dermis-fat grafting advantageous for the correction of combined conditions with PESS and socket contraction (fig. 2).

*Secondary Dermis-fat Grafting – Technique*

Like in any other autologous transplantation, the surgical procedure involves two steps: (1) harvesting the transplant and (2) preparation of the recipient site and implantation of the graft. The procedure is performed under general anaesthesia. The first step is usually the harvesting of the dermis-fat graft (fig. 3). The favourite donor site is the upper outer quadrant of the gluteal region. This is not a weight-bearing area, there is no risk of damaging the sciatic nerve and even a bikini will hide the scar. Furthermore, the dermis itself in this area is stronger compared to other areas, which is advantageous for graft stability. For harvesting the graft it is necessary to place the patient in a sideways position on his contralateral hip. Any damage to one of the ex-



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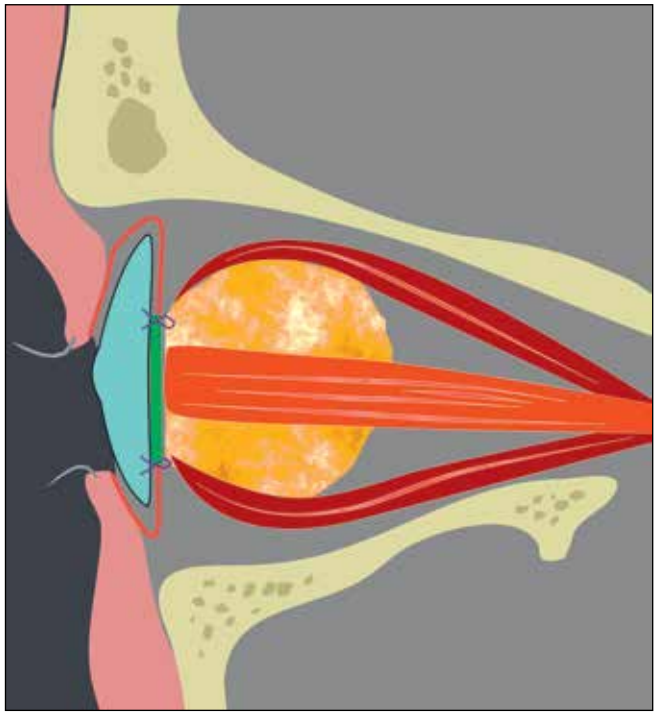

**Fig. 2.** Dermis-fat grafting in the anophthalmic socket; green line indicating the area of spontaneous epithelialization.

tremities or the neck must be avoided by meticulous bedding, which is usually performed together with the anaesthesiologist. After an accurate disinfection of the surgical region with 10% polyvidone-iodine solution, the dermis-fat graft is harvested from an area 5 cm below the centre point of a line joining the anterior iliac crest and the sciatic tuberosity. A circle with a maximum diameter of 25 mm is marked on the skin before it is incised superficially with a No. 15 blade, the incision not exceeding into the dermis. Intradermal injection of saline solution into the demarcated area facilitates the de-epithelialisation of the skin. Using a No. 20 blade, positioned nearly parallel to the skin surface and moved in a rotational manner, facilitates the removal of the epidermis (fig. 3a). A deep incision is then made along the incision line perpendicular to the surface, through the dermis and into the subcutaneous fat (fig. 3b). The graft is severed from the donor site, with special attention given not to damage the muscle fascia (fig. 3c). The graft is preserved in isotonic saline solution, while the donor site is closed with multiple (usually 3–4) interrupted 2-0 absorbable sutures (Vicryl™ 2-0) placed through the fatty tissue and subcutaneous tissue. Skin closure is performed with 2-0 black silk horizontal mattress sutures. Steri-strips™ are placed across the wound, and a pressure dressing with eudermic elastic plaster is applied. Harvesting the graft may take about 10–15 min.

After repositioning the patient into the supine position, the socket is prepared to take the graft. The procedure now is more dependent on the condition of the socket.



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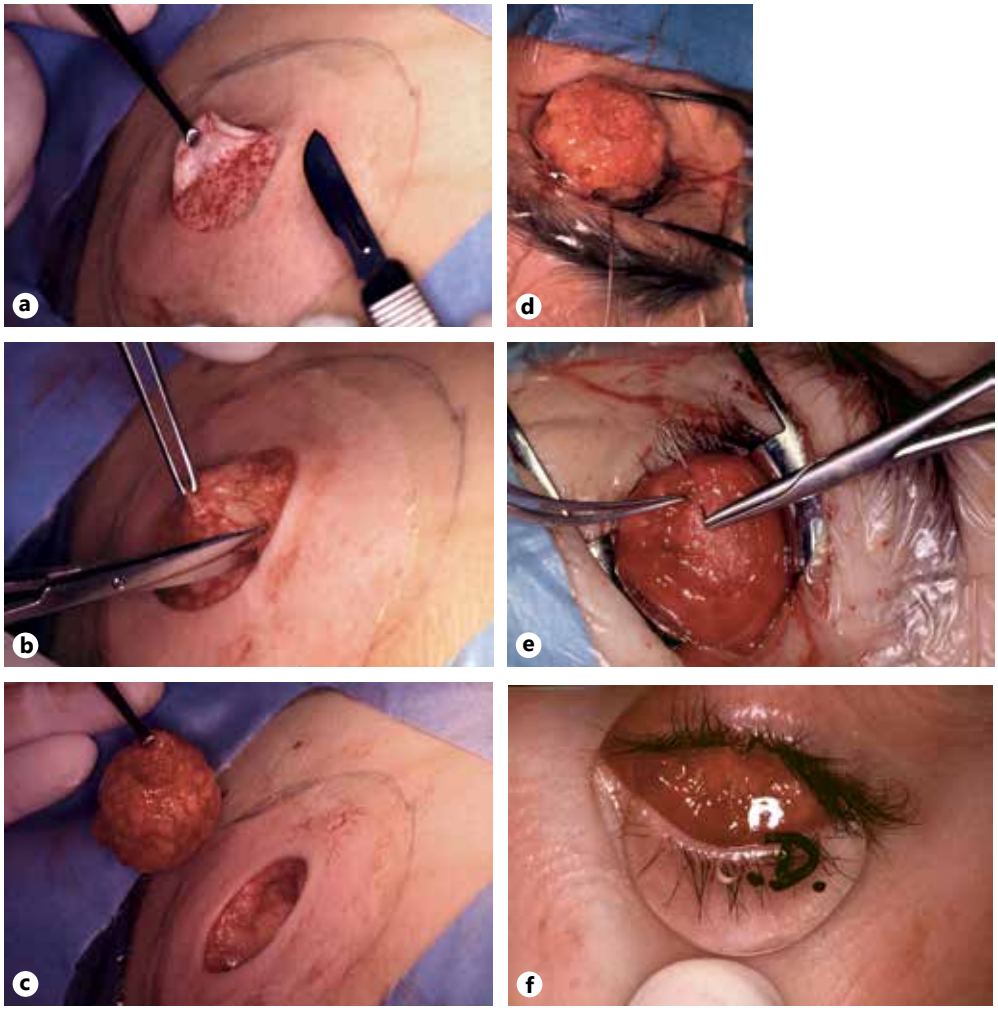


**Fig. 3.** Dermis-fat grafting. **a** Dermis-fat graft harvesting from the gluteal area: de-epithelialization using a No. 20 blade. **b** Transsection of fatty tissue after complete incision of the dermis layer. **c** Removal of the complete dermis-fat graft. **d** Insertion of the graft into the socket. **e** Suturing the recipient conjunctiva at the edge of the graft. **f** Insertion of a conformer at the end of the surgery.

In the case of an eroding or extruding orbital implant, the conjunctiva is incised circularly around the extruding part of the alloplastic implant. It is mandatory not to leave any conjunctival tissue in the depth of the orbital tissue to avoid the development of conjunctival implantation cysts. The orbital implant is then mobilised and finally explanted.

If no implant is present, a space to accommodate the dermis-fat graft is accomplished by blunt dissection only and spreading of the scissors. Any attempt to perform further dissection in order to expose remnants of the extraocular muscles should be avoided. Preparation and dissection in the orbital soft tissues should be as atraumatic



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