

Complications in Cranio-Maxillofacial and Oral Surgery

Robert Gassner
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 Springer

Editor
Robert Gassner
Department of CMF and Oral Surgery
Medical University of Innsbruck
Innsbruck
Austria

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*To all my inspiring local and international friends, colleagues,
companions, and great individuals on this small planet on my
academic, surgical, and personal paths who enrich my life,
especially my family*

Robert Gassner

Foreword

It is a pleasure and a honor for me to have been invited to write the introduction for the first edition of the book *Complications in Cranio-Maxillofacial and Oral Surgery* edited by Prof. Robert Gassner from Innsbruck, Austria.

In this international endeavor, Prof. Gassner's deep knowledge and great experience in the field of oral and cranio-maxillofacial surgery are reflected in a work that will fill an important space in the literature of the specialty. This book cannot be missed in the library of all those professionals who are dedicated to the study and treatment of the different areas of cranio-maxillofacial and also oral surgery.

The topic "complications" is of great importance due to its frequency and the consequences that it implies, both in terms of the impact on the patients and also the legal aspects. We appreciate the contribution of this work to the best knowledge of this aspect of oral and cranio-maxillofacial surgery, rarely systematized in such a structured way. It is really a pleasure to highlight the great international group of coauthors of recognized prestige who have contributed to make this book a reality. Throughout the book, the authors have achieved to make a very complete review of the various aspects of the topic "complications," which will contribute to an update of the reader's knowledge regarding the understanding and management of the possible complications in such important fields like the treatment of congenital or acquired deformities, facial trauma, TMJ pathology or tumors, and reconstructive surgery, among other areas. A special mention is deserved for the inclusion of very specific chapters such as complications of skull base surgery or radiation therapy; the latter written by the editor of the book itself.

Summarizing, based on the fact that a better knowledge of the complications will help to prevent and diagnose them in an early and adequate way, I am sure that this book will contribute to the best treatment of our patients. May I congratulate Robert Gassner for the initiative as well as all the prestigious authors who have participated in the edition of this new contribution to the scientific literature.

Julio Acero
Past President of International Association of Oral and Maxillofacial
Surgeons, President of the European Association of CranioMaxillofacial
Surgeons, Department of Oral and Maxillofacial Surgery
Ramón y Cajal and Puerta de Hierro University
Hospitals, University of Alcala,
Madrid, Spain

Prologue: A Short Note on Wisdom Teeth and Related Complications

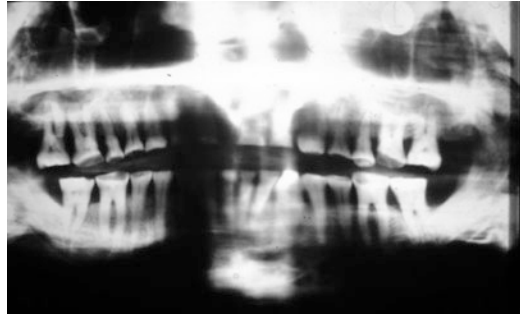


Fig. 1 Zonarc panoramic radiograph of the Iceman—September 1991. (Gassner, K: The Dentition of the Iceman. Diploma Thesis, 2018)

The Iceman (en.wikipedia.org/wiki/Oetzi), a 5300-year-old mummy, was found in the Tyrolean Alps in September 1991 and revealed to have a dentition of 28 teeth without wisdom teeth.

This image was taken in September 1991 when the Iceman underwent a Zonarc Panoramic Radiograph at the University Hospital of Innsbruck, Tyrol, Austria, which allowed the examination of patients in a supine position.

Regarding the field of dentistry and medicine, especially oral surgery but also craniomaxillofacial surgery, one of the stunning findings of the radiograph revealed that the iceman did not have wisdom teeth.

Until today, wisdom tooth removal may pose tremendous life-lasting consequences due to their position in the jaw. Therefore, while at the dental office adolescents should be evaluated whether wisdom teeth develop correctly and whether there is enough space for them before they harm neighboring teeth, interfere with their roots, or the infra-alveolar nerve.

There is always a plethora of general risks due to wisdom tooth removal such as pain, swelling, bleeding, inhibition of swallowing, limited mouth opening, mild fever, changes of blood pressure or heart rate, and side effects affecting nervous system (anxiety, seizures, breathing). Wisdom teeth themselves may develop pain, tooth decay, cysts, damage of neighboring roots, pressure on dental arches, and promote inflammatory conditions with bone infections surrounding them. Finally retained wisdom tooth may inhibit the insertion of crowns or bridges on second molars, the implementation of partial or full dentures.

Special risks of wisdom tooth removal are damage of the neighboring tooth/crown, displacement of the tooth or parts of it in the soft tissue, remaining root tips, broken drill heads, oroantral communication or tuber fracture in the upper jaw, nerve damage of the intra-alveolar nerve, lingual nerve, or mandible fracture even weeks after successful wisdom tooth removal. In very rare cases, bone infections may not only develop into osteomyelitis with the leading sign of lip numbness and limited mouth opening but also into life-threatening sepsis and even death.

In conclusion, it can be stated that the presence of all these wisdom tooth-related risks put humans nowadays in a precarious situation. They are at a higher risk than the Iceman with his 28 teeth when discussing wisdom tooth-related survival.

Robert Gassner

Acknowledgments

I am thankful to Dr. Sverre Klemp from Springer who approached me in Hong Kong at the ICOMS 2017 to edit a book on *Complications in Cranio-Maxillofacial and Oral Surgery*. I hesitated but he insisted based on Springer's analysis that I know clinically active experts around the globe who will accept the invitation to prepare book chapters.

I am also thankful to Ahmad Ejaz from Springer for his advice who was extremely helpful and effective in collecting all chapters from around the globe. I am thankful to Daniela Heller from Springer. She was always there for all questions I had regarding the book project.

I am deeply thankful to all my coauthors for their great efforts and commitment to contribute to this book especially **Srinivas Gosla Reddy** from Hyderabad, India, on Complications in Cleft Lip Palate Surgery, **B J Costello** from Pittsburgh, Pennsylvania, on Complications in Craniofacial Surgery, **Suzanne McCormick** from Encinitas, California, on Complications in Distraction Surgery, **Roger Moreira** from Goiânia, Brazil, on Complications in Orthognathic Surgery, **Radhika Chigurupati** from Boston, Connecticut, on Complications of Odontogenic and Non-odontogenic Infections, **Bilal Al-Nawas** from Mainz, Germany, on Complications in Oral Implant Placement, **Tetsu Takahashi** from Tohoku, Japan, on Complications in TMJ Surgery, **Sven OTTO** from Munich, Germany, on Complications treating MRONJ, **Andreas Kolk** from Innsbruck, Austria, on Complications due to Removal of Plates and Screws, **Wilhelm Eisner** from Innsbruck, Austria, on Complications and Orofacial Pain, **Gregorio Sanchez Anicheto** from Madrid, Spain, on Complications in Skull Base Surgery, **Bernhard Frerich** from Lübeck, Germany, on Complications in Maxillofacial Cancer Resection, **Volker Schartinger** from Innsbruck, Austria, on Complications in Neck Dissection, **Christos Perisanidis** from Athens, Greece, on Complications in Free Flap Reconstruction, and their coworkers, respectively. They are all highly educated and accomplished surgeons and also scientists. It is a real privilege and pleasure to share this book authorship with all of them.

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Robert Gassner

Part I

Malformations



Complications in Cleft Lip and Palate Surgeries

1

Srinivas Gosla Reddy and Ashish Fanan

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S. G. Reddy (✉) · A. Fanan
GSR Institute of Craniomaxillofacial and Facial
Plastic Surgery, Hyderabad, Telangana, India
e-mail: goslareddy@craniofacialinstitute.org

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1.1 Introduction

Cleft lip and palate (CLP) is a three-dimensional anomaly involving hard and soft tissues of the face. The comprehensive treatment of CLP deformities requires a thorough understanding of the deformed anatomy and a balance between intervention and growth.

In the past, poor outcomes were the result of nonexistent protocols, fragmented care, and lack of periodic assessment. Many of the developed countries now have a well-structured and organized cleft team centers. However, the situation in most of the developing countries is quite different, where they lack properly trained medical personnel which hampers delivery of high-quality care to the orofacial cleft patients. Funding in these resource-poor nations is managed through outreach programs of various philanthropic organizations around the world.

Complications can occur in the management of cleft patients due to lack of understanding of surgical principles and improper techniques. This chapter provides a detailed classification of complications in cleft lip and palate surgeries and insights into their comprehensive multidisciplinary management.

1.2 Overview of Complications Associated with Cleft Lip and Palate Patients

Classification of complications

General anesthesia

I. Airway complications

1. Difficult intubation
2. Tube disconnection and tube compression

3. Desaturation
4. Disconnection or accidental extubation
5. Laryngospasm and bronchospasm

II. Other complications

1. Arrhythmia
2. Hyper-/hypothermia

Classification of complications

Surgery

I. Cleft lip

A. Intraoperative complications

1. Incorrect markings
2. Blood loss

B. Immediate postoperative complications

1. Infection and tissue necrosis
2. Wound dehiscence
3. Hematoma formation

C. Late postoperative complications

1. White roll mismatch
2. Vermillion notching (whistle lip deformity)
3. Hypertrophic scar/contracture
4. Shortening of lip length
5. Nostril asymmetry
6. Differences in alar base
7. Infra-sill depression
8. Prolabium necrosis

Classification of complications

Surgery

II. Cleft palate

A. Preoperative complications

1. Otitis media
2. Aspiration pneumonia
3. Nutritional deficiency

B. Intraoperative complications

1. Blood loss
2. Damage to the pedicle

C. Immediate postoperative complications

1. Bleeding
2. Airway obstruction
3. Wound dehiscence/infection
4. Hanging palate
5. Erosion of corner of mouth

D. Late Postoperative complications

1. Fistula formation
2. Velopharyngeal incompetence
3. Maxillary hypoplasia
4. Recurrent ear infections

Classification of complications**Surgery****III. Alveolar bone graft****Recipient site****A. Intraoperative complications**

1. Perforation of nasal layer
2. Damage to the tooth/tooth bud

B. Postoperative complications

1. Graft exposure

Donor site (anterior iliac crest)**A. Intraoperative complications**

1. Bleeding
2. Fracture of iliac cortex
3. Peritoneal perforation
4. Injury to inguinal ligament
5. Injury to ilioinguinal nerve

B. Postoperative complications

1. Deep hematoma
2. Seroma
3. Infection and wound dehiscence
4. Meralgia paresthetica
5. Hernia
6. Gait changes
7. Foot drop
8. Cosmetic defect:
 - (a) Hypertrophic scar
 - (b) Pelvic brim defect

Classification of complications**Surgery****IV. Orthognathic surgery****A. Intraoperative complications**

1. Hemorrhage
2. Bad split/fracture
3. Nerve injury
4. Damage to the tooth buds

B. Postoperative complications

1. Vascular compromise; complete or partial necrosis
2. Palatal perforation
3. Malunion/nonunion
4. Malocclusion
5. Relapse
6. Temporomandibular joint effects
7. Sensory impairment
8. Cranial nerve palsies/cavernous sinus thrombosis
9. Blindness; partial or complete
10. Maxillary aneurysm

11. Avascular necrosis

12. Velopharyngeal insufficiency (VPI)

Classification of complications**Surgery****V. Distraction osteogenesis****A. Intraoperative complications**

1. Hemorrhage
2. Bad split/fracture
3. Nerve injury
4. Damage to the tooth buds

B. Postoperative complications**Intradistraction complications**

1. Pin infections, pin and device loosening
2. Device failure
3. Inappropriate distraction vector
4. Premature consolidation
5. Coronoid process interference
6. Fibrous pseudoarthrosis
7. Trismus

Postdistraction complications

1. Delayed consolidation
2. Premature consolidation
3. Malocclusion
4. Growth disturbances

Classification of complications**Surgery****VI. Rhinoplasty****A. Intraoperative complications**

1. Bleeding
2. Cartilage fracture
3. Buttonholing of skin
4. Perichondrium tear

B. Immediate postoperative complications

1. Transient numbness and pain
2. Hematoma
3. Infection and wound dehiscence
4. CSF rhinorrhea
5. Olfactory disturbances

C. Late postoperative complications

1. Columellar skin necrosis
2. Graft/implant migration
3. Nasal stenosis/blockage
4. Septal perforation
5. Nasal valve collapse
6. Poor hypertrophic scar

Classification of complications**Surgery****VII. Complications associated with syndromic patients****A. Pierre Robin syndrome****B. Velocardiofacial syndrome**

1.3 Complications Associated with Anesthesia

1.3.1 Airway Complications

Most anesthetic complications in cleft surgeries are related to *airway management* namely difficult intubation, tube disconnection, tube compression, desaturation, disconnection, or accidental extubation. Other complications are laryngospasm, bronchospasm, and airway edema.

Children with hypoplastic mandible or wide cleft (common in Pierre Robin syndrome) are at increased risk of tongue prolapse into the pharynx and pose a problem during induction of anesthesia. Postoperative respiratory obstruction may result following the closure of wide cleft palate or syndromic cleft associated with hypoplasia of mandible, hematoma, or due to accidental left-over packs. There is also change in oral/nasal airway dynamics especially in syndromic children that may present with the problem of respiratory obstruction in the postoperative period. Use of nasopharyngeal airway or/and tongue suture to allow forward traction can help in such a situation.

The optimum anesthetic management will depend on the age of the patient, the availability of intraoperative monitoring equipment, anesthetic drugs and expertise, and the level of post-operative care that is available.

1.3.1.1 Difficult Intubation

If the airway becomes obstructed after induction of the patient, the maneuvers to be followed are turning the patient lateral or semi-prone and the use of a nasal or oral pharyngeal airway. *No neuromuscular blocking agents should be given until one is sure that the lungs can be ventilated with a mask.* The laryngeal mask airway may help and enable the patient to achieve adequate depth of anesthesia for direct laryngoscopy and intubation to be tolerated. In the event of being unable to secure the airway, consideration should be given to allowing the patient to wake up and deferring surgery to when they are older and have more structural and neuromuscular maturity [1, 2].

1.3.1.2 Tube Disconnection and Tube Compression

The ET tube should be properly secured with the help of adhesive tapes. Scrubbing solutions should not interfere with the adhesive tapes. Muhammed et al. devised an L-shaped metal rod used to prevent endotracheal compression during palatopharyngeal or intraoral surgery (Fig. 1.1a) [3]. Also tongue blade with longer groove for the endotracheal tube can be used to prevent tube dislodgement (Fig. 1.1a, b).

1.3.1.3 Desaturation

Desaturation can occur due to preoperative infection and inflammation of the respiratory tract,

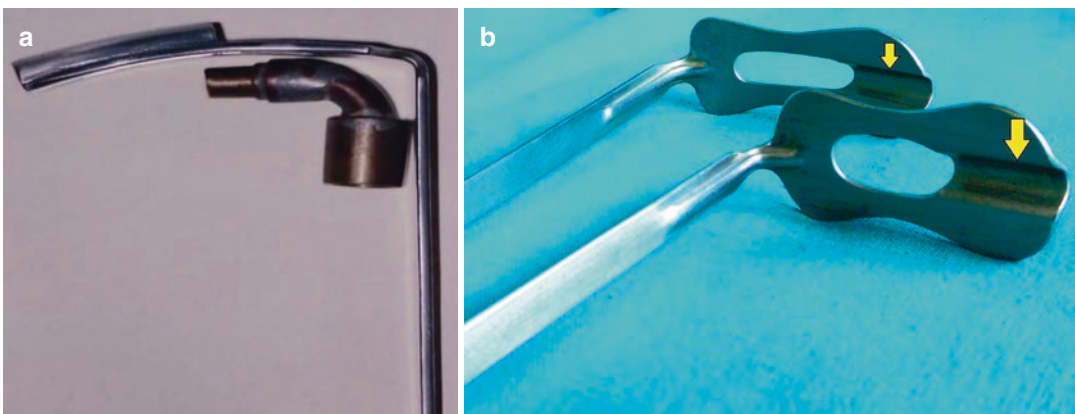


Fig. 1.1 (a) Metal rod with tongue blade. (b) Tongue blade with longer groove

tube compression, laryngospasm, or bronchospasm. Hence it is essential to defer the surgery till the patient's pulmonary health and functional reserves return to the normal.

1.3.1.4 Accidental Extubation

Accidental extubation when positioning the head for surgery is minimized if the tube is placed 1.5 cm above the carina. Inadvertent extubation is mostly associated manipulation during placement of gag for cleft palatal surgery. Immediate reintubation should be performed with constant monitoring of the oxygen saturation. Hence, it is mandatory to inform the anesthesia team during manipulation of the gag during surgery.

1.3.1.5 Laryngospasm and Bronchospasm

Laryngospasm is common in children with history of asthma or upper airway infections. Precipitating factors of laryngospasm are airway manipulation, blood/secretions in the pharynx, regurgitation/vomiting, surgical stimulus, moving patient, irritant volatile agent, or failure of anesthetic delivery system.

Bronchospasm usually manifests during anesthesia as an expiratory wheeze, prolonged expiration, and/or increased inflation pressures during intermittent positive pressure ventilation. The chest may be silent on auscultation and the diagnosis may rest on correct assessment of increased inflation pressures.

Laryngospasm is relieved by giving muscle relaxant, by chin lift jaw thrust maneuver, and by oxygenation (100%) whereas bronchospasm is relieved through intravenous hydrocortisone and deriphyllin.

1.3.2 Other Complications

1.3.2.1 Arrhythmia

Preoperative, perioperative, and postoperative arrhythmias in cleft lip and palate patients are associated mainly with hemodynamic change or any previously diagnosed underlying cardiac disease.

1.3.2.2 Hypo-/Hyperthermia

Children tend to lose more heat through conduction and radiation than adults, due to less insulating subcutaneous fat and a higher surface area to volume ratio. Core temperature monitoring probes, body warmers, and fluid warmers should be available in the operating room. It is recommended that recommend active warming be used during the first 30 min if the surgery is expected to last for <2 h, and no such measures are required if the expected duration is >2 h [4]. Operating room temperature should be maintained between 21 and 24°C with a humidity of 40–50%.

Anesthetic management of cleft repair surgeries requires a skilled professional, meticulous monitoring, and postoperative care in an intensive care unit set up to minimize the complications.

1.4 Complications Associated with Surgery

1.4.1 Complications Associated with Cleft Lip Surgery

1.4.1.1 Intraoperative Complications

Incorrect Markings

Incorrect markings on the lip are due to lack of proper understanding of the anatomical landmarks and cleft anatomy. This error can also occur due to improper magnification and illumination.

Blood Loss

Mean estimated blood loss during unilateral cleft lip surgery was 26–47 mL. Mean estimated blood loss in unilateral cleft lip surgery was not significantly different from that of bilateral cleft lip surgery ($P = 0.46$) [5]. However, a significant positive correlation between duration of surgery and blood loss is established.

How to Avoid This Complication

Compression of superior labial artery during dissection with index finger and thumb can significantly prevent blood loss during surgery.

How to Treat This Complication

Cleft lip surgery is a low volume blood loss surgery. This surgery very rarely requires blood transfusion.

1.4.1.2 Immediate Postoperative Complications

Infection, Wound Dehiscence, and Tissue Necrosis

This can occur due to tension in the repair or improper suturing of the orbicularis oris muscle, trauma, etc. Maintaining a clean wound is essential. It is widely accepted that the cleft lip wound should be cleaned after each feeding, with gentle action and no repetitive rubbing. A sterile cotton swab, normal saline solution, and topical antibacterial ointments are recommended for wound dressing.

Omitting this essential step paves the way for infections which leads to wound dehiscence and finally even to tissue necrosis (Fig. 1.2).

How to Avoid This Complication

Tension in the repair can be avoided by extensive subperiosteal elevation of the facial mask especially in wide clefts. Also suturing of the orbicularis oris muscle should be performed meticulously.

How to Treat This Complication

Infection must be controlled and if necessary secondary surgery is required after 3–6 months.

1.4.1.3 Late Postoperative Complications

White Roll Mismatch

Malalignment of white roll of even 1 mm is visible from a conversational distance. It is one of the most

common and easily discernable sequela of cleft lip surgery. In bilateral cleft lip repairs, preservation of prolabial and lateral element white rolls can result in the triple line effect of the prolabial white roll, scar, and lateral white roll underneath.

How to Avoid This Complication

A good tip is to mark the white roll points with ink before local anesthesia injection to ensure accurate alignment which is maintained by placing 6-0 prolene sutures above and below the white roll. This deformity can be avoided by adequate rotation of the noncleft segment.

How to Treat This Complication

White roll mismatch is corrected by a diamond-shaped excision of the white roll scar extending above and below the roll (Fig. 1.3).

Vermillion Notching (Whistle Lip Deformity)

The vermilion of the lip is a composite structure consisting of the orbicularis oris muscle, fat, vermilion, and specialized epithelium. Vermillion notching is a discontinuity in the free border of the vermilion. This may be central (“whistle deformity”) or lateral along the line of the scar. It may be caused by:

- Inadequate rotation
- Inversion of the sutured edges
- Orbicularis oris marginalis muscle deficiency
- Straight line scar contracture
- Failure to fill central tubercle with lateral vermilion tissues
- Diastasis of the orbicularis muscle at the base of the nose resulting in an upward pull on the central tissue or a combination of these (Fig. 1.4a, b)



Fig. 1.2 Infection wound dehiscence and tissue necrosis



Fig. 1.3 White roll mismatch



Fig. 1.4 (a) Vermillion notching. (b) Vermillion notching whistle lip deformity

How to Avoid This Complication

This deformity may be prevented by properly choosing the Cupid's bow point on the lateral lip segment, i.e., Nordhoff's point. An incision placed too laterally can cause short lip in horizontal/transverse dimension. An incision placed too medially compromises the vertical height of the lip and vermilion. Also excessive dissection of pars marginalis muscle should be avoided to avoid this complication.

How to Treat This Complication

There are various techniques to correct the vermilion deficiency, the choice of which should be based upon the underlying cause. If the deformity is due to a scar contracture, a z plasty can be performed to release the scar. If the deformity is due to lack of orbicularis muscle bulk in the vermilion, it can be addressed by a wedge-/diamond-shaped excision and reorientation and resuturing of the orbicularis muscle. This can prevent scar contracture and notching during function. The vermilion bulk can also be augmented by free fat graft, fillers, or any autologous material. A severe vermilion deficiency in the central tubercle region with no locally available tissues can be corrected by Abbe's flap.

Hypertrophic Scar Contracture

Hypertrophic scars can result due to

- Local wound tension
- Infection
- Improper tissue handling
- Genetic predisposition (Fig. 1.5)



Fig. 1.5 Hypertrophic scar contracture

How to Avoid This Complication

Hypertrophic scars can be prevented by relieving any unnecessary tension, meticulous dissection of involved structures, and proper muscle approximation. This allows skin suture placement without any tension. A good wound care is equally important to prevent infections. These scar management methods should be employed for 6–12 months until the scar matures completely. Choice of suture materials and atraumatic suturing techniques also play an important role in the fate of the scar.

How to Treat This Complication

Scar management methods are also employed to achieve an acceptable scar which includes taping, scar massage, and sun protection. Unsightly scars can be managed by scar excision procedure down to the orbicularis muscle layer and sufficiently mobilizing the skin flaps for tension-free closure. The scar tissue including the skin and muscle if scarred is excised and resuturing is performed. If a hypertropic raised scar starts developing post surgery, it can be managed by

intralesional steroid injections. Parents of the patients should be counseled for the amount of the time it will take for the scar to fade and not vanish completely.

Shortening of Lip Length

Short lip length can result from

- Failing to balance the cupid's bow
- Poor scarring
- Straight line scar
- Under rotation of the flap

How to Avoid This Complication

The cupid's bow should be horizontal before the start of suturing. A straight line scar should be avoided. Adequate rotation of the flaps should be achieved before suturing.

How to Treat This Complication

Lip deficiencies of up to 1 mm can be corrected by an elliptical excision of previous scar by *Rose Thompson effect*. Any major discrepancy in vertical height requires complete revision of the lip which includes release of all the abnormal attachments, meticulous muscle suturing, and accurate leveling of cleft side of cupid's bow by giving an adequate back cut (Fig. 1.6).

Nostril Asymmetry and Differences in Alar Base

Nasal asymmetry in cleft patients is caused by three important anatomical changes:

- Nasal septum deviation
- Significant distortion of the alar cartilages caused by separation of the bone structures and soft tissues



Fig. 1.6 Shortening of lip

- Unleveling of the maxillary and alveolar bone resulting from the spreading of the palatal shelves

Unleveling of the bone of the alveolar arches, viz. greater segment and smaller segment and maxilla, exerts a vector of caudal force over a nasal wing, as well as overall nose structures; this is one of the important anatomical limitation to obtain final nasal symmetry after lip repair.

How to Avoid This Complication

Morphofunctional reposition of the septal cartilage from its physiological position to its anatomical position is also an important factor to obtain nasal symmetry. Mulliken and Martínez-Pérez observed 23% postoperative nasal asymmetry in unilateral cleft patients [6]. Cutting and Dayan described the inclusion of percutaneous sutures that exert a vector of force contrary to the primary caudal force originating from the alveolar gap resulting from the spreading of the palatal shelves [7]. Postoperative nasal splinting in the primary management of the unilateral cleft nasal deformity serves to preserve and maintain the corrected position of the nostril after primary lip and nasal correction, resulting in a significantly improved aesthetic result. Therefore, it is recommended that all patients undergoing primary correction of complete unilateral cleft deformity use the nasal retainer postoperatively for a period of at least 6 months [8] (Fig. 1.7).

How to Treat This Complication

Preschool (5–6 years of age) rhinoplasty is generally performed if there is a significant deformity mostly involving the lower lateral cartilages or is delayed until the nasal growth is complete (16 years of age).

Nasal Stenosis

Nasal stenosis can occur due to excessive scarring of the incision taken around the ala similar to conventional Millard's incision. Salyer recommended leaving the nostril larger because tightening a laterally displaced alar base is easier than secondary correction of tight external nares (Fig. 1.8).



Fig. 1.7 Nostril asymmetry



Fig. 1.8 Nasal stenosis

How to Avoid This Complication

Nasal stent post surgery can be used to prevent nasal stenosis.

How to Treat This Complication

Surgical repair can be carried out, viz. nasolabial flaps, boomerang flap, vestibular rotation flap.



Fig. 1.9 Infra-sill depression

Infra-sill Depression

An infra-sill depression indicates lack of muscle bulk at the base of the nose. Another cause of this depression is the thin dermis in the tip of the advancement flap (Fig. 1.9).

How to Avoid This Complication

A good amount of orbicularis oris muscle bulk at the base of the nose is recommended during the suturing of the muscular part.

How to Treat This Complication

A dermal draft or dermal fillers can be used to elevate the infra-sill depression.

Prolabial Necrosis (Bilateral Cleft Lip Cases)

Devitalization and necrosis of prolabium is a feared complication in bilateral cleft lip surgeries. It was initially thought that a bilateral cleft lip repair required staged procedure since the prolabium could not bear the surgical insult of a single-stage technique. However, the true incidence of prolabial necrosis is not known and the risk of prolabium necrosis still exists. Any aggressive open technique in the nose during primary reconstruction also carries a higher risk of skin necrosis to the columella and prolabium [9] (Fig. 1.10a, b).

How to Avoid This Complication

It is important to increase the prolabial flap thickness when it is raised from the philtral

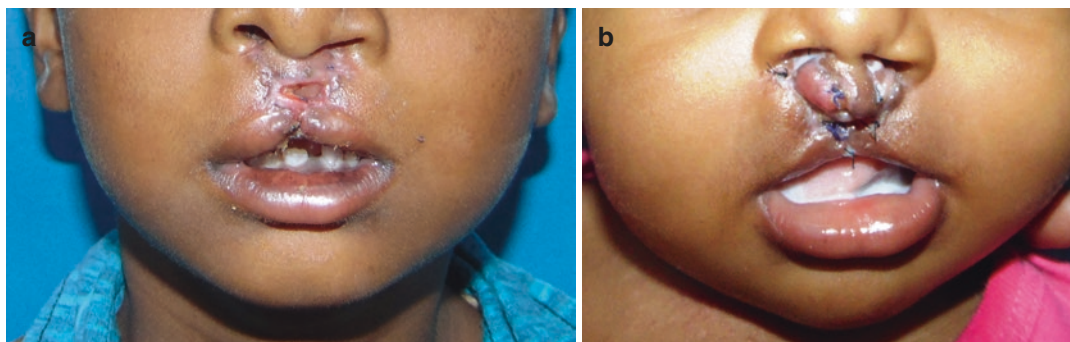


Fig. 1.10 (a) Prolabial necrosis. (b) Prolabial necrosis

notch and ensure a tension-free closure. Capillary refill of the flap and its color should be checked periodically intraoperatively and postoperatively. Bipolar cautery should be used judiciously on the prolabial flap. After surgical intervention, the prolabium should be pink and perfused to ensure survival. If it appears blanched, the sutures should be removed to help prevent necrosis.

How to Treat This Complication

Prolabial flap necrosis will heal as a scar with poor cosmetic outcomes and may lead to short and tight upper lip. Local tissue arrangement including complete muscle repositioning methods should be employed. Abbes flap should be employed when there is a loss of tissue from multiple operations or when the prolabium has been discarded. Abbes flap reconstructs the lip in all the three layers.

1.4.2 Complications Associated with Cleft Palate Surgery

1.4.2.1 Preoperative Complications

Otitis Media

The hearing loss due to otitis media in a cleft patient is a well-known complication, but generally gets ignored. The abnormal reflux of fluids and food around eustachian tube causes chronic inflammation and obstruction of the tube leading to otitis media.

How to Treat This Complication

These patients should undergo regular otological and audiological follow-ups with appropriate interventions. These interventions can be in the form of grommets and myringotomy tubes to drain the fluid in middle ear cavity. These can be used in patients with age group of 6 months to 12 years [10]. Eustachian tube dysfunction resolves in at least 50% patients after palate repair and resolves in most patients by the age of 5 [10].

Aspiration Pneumonia

Aspiration pneumonia was defined as the coexistence of pneumonia at chest radiography with a history of frequent choking during feeding. The incidence of aspiration pneumonia in infants with cleft palate is more than infants born without cleft palate. The faulty feeding position (on the child's back) is the main reason for aspiration of the contents.

How to Avoid This Complication

The parents and the caretakers should be educated and demonstrated about feeding the baby in a proper way (Fig. 1.11).

Nutritional Deficiency

Studies have shown that children with clefts have lower height and weight when compared to a control group, especially during the first year of life [11, 12]. Children with either cleft lip or palate have a short, fast, uncoordinated, and ineffective intraoral suction, due to abnormal muscular



Fig. 1.11 Feeding position for a cleft baby

attachments which may cause asphyxia because of the entrance of milk into the nasal cavity, and also excessive air ingestion [13, 14]. The factors that optimize weight gain include proper feeding advice and multidisciplinary integrated care. The main priority during the first months of life, including those with cleft palate, should be appropriate nutrition along with multivitamin, calcium, and other dietary supplements.

How to Avoid This Complication

The parents and the caretakers should be educated about the feeding technique, viz.:

- Positioning the baby
- Burping the baby after the feeding
- Feeding the baby in short interval of times

1.4.2.2 Intraoperative Complications

Blood Loss

An average blood loss of 46 mL with palatoplasty (3–12% of expected blood volume) was reported by Kulkarni et al. [2]. The alteration of the heart rate is a direct consequence and the lowering of the body temperature is an indirect consequence of blood loss. The reduction of the intraoperative blood loss is one approach to decreasing the probability and the severity of intra- and postoperative complications. A blood loss of about 50 mL during infant surgery with total patient

blood volume of 400–700 mL can disturb the circulation, requiring a transfusion of banked blood or plasma substitutes. A precise assessment of the blood loss is therefore vital in order to find the balance between over-transfusing and unnecessary transfusion. Ringers lactate should be infused (considering 4-2-1 rule), 8–12 mL/kg/h throughout the procedure and 4–6 mL/kg/h for 4–6 h postoperative period. Intraoperative continuous monitoring should include heart rate, blood pressure, ECG, SpO₂, end tidal carbon dioxide (EtCO₂), temperature, and blood loss.

How to Avoid This Complication

The shortening of the duration of a cleft surgery is an important step to reduce the total loss of blood.

How to Treat This Complication

Blood loss up to 20% of total blood volume can be corrected with crystalloids (in 1:3 ratio) and if >20% with blood transfusion (in 1:1 ratio). Surgical site should be infiltrated with local anesthetic (1–1.5%) containing adrenaline (1:100,000).

Damage to the Pedicle

Damage to the pedicle can occur due to aberrant anatomy or improper surgical technique. Hence, a careful approach when dissecting in and around the pedicle is required. There is a network of anastomoses between the vessels that supply the hard palate and soft palate. Avoid using sharp instruments for elevation of the mucoperiosteal flaps.

How to Avoid This Complication

A wet gauze along with a freer elevator can be used to elevate the mucoperiosteal flap to prevent damage to the pedicle.

How to Treat This Complication

The most important are the anastomoses between the ascending palatine and lesser palatine arteries which acquire importance when the greater palatine artery is sectioned accidentally during palatoplasty. When a pedicle is damaged, minimal dissection in the soft palate region should be the rule.

1.4.2.3 Immediate Postoperative Complications

Bleeding

Slight oozing from the raw surfaces of the flaps is expected; however, it is very important that the patient does not leave the operating room until the bleeding is controlled. A fine tip bipolar cautery is used to cauterize the edges of the flaps. The Dingman retractor should be left in place until bleeding is controlled. Gelfoam or Surgicel or other hemostatic agents can also be able to control active bleeding. Patient's parents should be counseled beforehand regarding possibility of postoperative bleeding and the need to take the patient back to the operating room to reexplore the surgical site and cauterize the active bleeders.

How to Treat This Complication

Active bleeding can occur mostly due to accessory greater palatine or lesser palatine vessels. The patient should be taken to the operating room to cauterize the active bleeders.

Airway Obstruction

Patients with Pierre Robin sequence or other additional congenital anomalies have an increased risk of airway problems following palatoplasty. There is also change in oral and nasal airway dynamics especially in children with Pierre Robin Syndrome which may present itself in postoperative period and if severe enough can lead to respiratory obstruction. These patients must be identified prior to surgery so that they can be monitored and managed appropriately, minimizing the likelihood of major complications or death.

Postoperative respiratory obstruction may occur due to:

- Closure of wide cleft palates
- Hypoplastic mandibles in syndromic patients (PRS)
- Hematoma
- Accidental left-over packs
- Aspiration of secretions or blood, collected in the nasopharynx



Fig. 1.12 Wound dehiscence

How to Treat This Complication

Nasopharyngeal airways and tongue stitch can be used on emergency basis. Hence continuous monitoring of the respiratory distress (use of accessory respiratory muscles) and oxygen saturation (SpO_2) is essential.

Wound Dehiscence

Wound dehiscence is a surgical complication that results from poor wound healing. The nasal and oral layers of the surgical wound separate or the whole wound splits open. This dehiscence usually occurs between 7 and 10 days post surgery (Fig. 1.12).

Wound dehiscence varies depending on the technique of surgery and the type of cleft. The generalized causes are:

- Infection at the wound
- Tight sutures
- Poor knotting or tissue handling
- Inadvertent trauma to the wound after surgery
- Weak tissue or muscle at the wound area
- Incorrect suture technique used to close operative area
- Vitamin C deficiency

How to Avoid This Complication

Maintaining a good oral hygiene with strict diet instructions to the parents/caretakers of the patient.

How to Treat This Complication

Fistula formation can be a potential complication of wound dehiscence. No immediate management is required post-wound dehiscence.



Fig. 1.13 Hanging palate

The management of fistula formation is described further in details.

Hanging Palate

The anterior wound dehiscence results in the detachment of the mucoperiosteal flap from the alveolar margin (Fig. 1.13). This complication is very troublesome for the parents as well as the surgeon. It mostly occurs on the 4th or 5th postoperative day, the cause being hematoma formation between the mucoperiosteal flap and nasal layer.

How to Avoid This Complication

Good adaptation sutures preventing the dead space, including nasal layer and oral layer, is very important to prevent this complication.

How to Treat This Complication

An innovative management protocol using a methyl methacrylate obturator fixed to the alveolar arch has been described by K. Agrawal [15]. Use of adhesion systems, i.e., fibrin glue has also been advocated.

Erosion of Corner of Mouth

This can occur due to long operating hours for the palate repair (Fig. 1.14).



Fig. 1.14 Erosion of corner of mouth

How to Avoid This Complication

Release the gag if long operating hours are expected during the surgery.

How to Treat This Complication

Application of emollients and moisturizing ointments.

1.4.2.4 Late Postoperative Complications

Fistula Formation

An oronasal fistula is an abnormal communication between the oral cavity and the nose that occurs after surgical repair of a cleft palate. There is no consensus for the rate of fistula formation following surgery despite extensive research in cleft palate surgeries. A meta-analysis by Bykowski MR et al. reports fistula formation rates was 4.9% following cleft palate surgeries. However, the rate of ONF varies from 4 to 35% or even more in case of primary palatoplasty surgeries. Oronasal fistulae have been associated with severity and type of the cleft (Fig. 1.15a–c).

Palatal fistula can occur due to:

- Poor wound healing due to nutritional deficiency and anemia
- Tension or improper suturing technique
- Wound dehiscence
- Partial mucoperiosteal flap necrosis
- Infection
- Injury to the pedicle
- Hematoma formation

Most of the fistulas are observed in the early stages, i.e., within 2 weeks after palatal surgery.



Fig. 1.15 (a) Anterior palatal fistula. (b) Midpalatal fistula. (c) Junctional palatal fistula. (d) Junctional palatal fistula closure with local flaps. (e) Junctional palatal fistula closure with tongue flap

This condition has functional consequences because of fluid and air leakage. Air leakage can cause problems such as speech impairments due to nasal escape and nasal regurgitation. Fistulas causing disturbance in speech should undergo early repair, whereas the closure of fistulas not associated with speech problems should be delayed, if possible, until completion of orthodontic maxillary arch expansion. Fistula closures can also be combined with secondary alveolar bone grafting surgery [16].

How to Avoid This Complication

- Reduction in tension during suturing: A good nasal layer repair is critical in reducing the incidence of postoperative fistula. No technique is good if it does not allow closure of palate without tension. Any tension during palate repair will cause tear in mucoperiosteum when one tries to tighten the knots. The tension can be reduced by releasing the pedicle from the foramen, releasing lateral incision like in Von Langenbeck palate repair or separating the pedicle from the flap

especially in very wide clefts, e.g., syndromic patients.

- Oral hygiene maintenance: Infection is unlikely in younger babies, unless they are compromised either immunologically or nutritionally. In older children, infection is seen especially with poor dental and oral hygiene.
- Postoperative antibiotic pack: The rate of fistula formation after primary palatoplasty is significantly reduced if a pack soaked with antibiotic cream is placed on the palate postoperatively.

How to Treat This Complication

It is preferred to wait until 4 years of age when objective examination with the help of nasopharyngoscope or videofluoroscope is possible for the management of fistula closure with velopharyngeal incompetence. A turn-over flap and transposition flap from buccal, vestibular, or facial regions can be used. It is preferable to use local palatal mucosa or mucoperiosteal tissue to replace the defect (Fig. 1.15d). The aim of surgical management of the fistula closures should be *two layered tension free closure*. For large fistulas local tissue, a tongue flap may be employed. The base of the flap should be at least half the width of the tongue or two thirds the width of the fistula to ensure a rich blood supply [17]. This flap is beneficial for recurrent and recalcitrant fistulas with extensively scarred tissues (Fig. 1.15e).

With extremely collapsed alveolar arches with large fistulas, orthodontic expansion should be performed followed by free tissue transfer. A radial forearm flap is mostly preferable since it is thin, freely mobile, mostly hairless with a long vascular pedicle. For multiple hard palate fistulas, complete redo-palatoplasty should be employed. Fistulas in soft palate and junction of hard and soft palate are mostly associated with VP dysfunction, a Furlow's double-opposing palatoplasty should be performed. It has the advantage of closing the fistula as well as lengthening the soft palate which helps to improve speech [16].

Velopharyngeal Incompetence

Velopharyngeal insufficiency (VPI) is described as the inability to close the velopharyngeal sphincter because of an anatomical or structural deficit during the production of sounds during speech. The inadequacy of speech and voice derived from velopharyngeal insufficiency is a major stigma for cleft palate patients.

Complete velopharyngeal closure effectively seals off the nasal cavity from the oral cavity, which is necessary for the production of all vowels and oral consonants. Patients with VPI present with nasal air escape and hypernasality during speech.

The evaluation of a patient with repaired cleft palate includes meticulous speech assessment by a trained speech therapist with familiarity of patients with cleft palate. Speech therapists assess the patient's intelligibility in speech, nasal emissions, and vowel and consonant production errors. Speech articulation errors are primarily addressed with the use of intensive and regular speech therapy. Hypernasality due to VPI requires surgical management.

How to Treat This Complication

The main aim of the VPI surgeries should be

- Separation of the oral and nasal components
- Adequate velar length
- Functional transverse orientation of the levator muscle sling

The velopharyngeal closure pattern and size of the velopharyngeal gap are the two important factors that guide the surgical treatment plan which includes:

- Pharyngeal flap
- Furlow's double-opposing Z-plasty palatoplasty
- Modified Furlow's Z-plasty (Fig. 1.16a)
- Buccal myomucosal flap (Fig. 1.16b)
- Combination of the above procedures

The most common age group for performing VPI surgeries is 4–6 years. Early interventions are associated with better speech outcomes. Fukushima

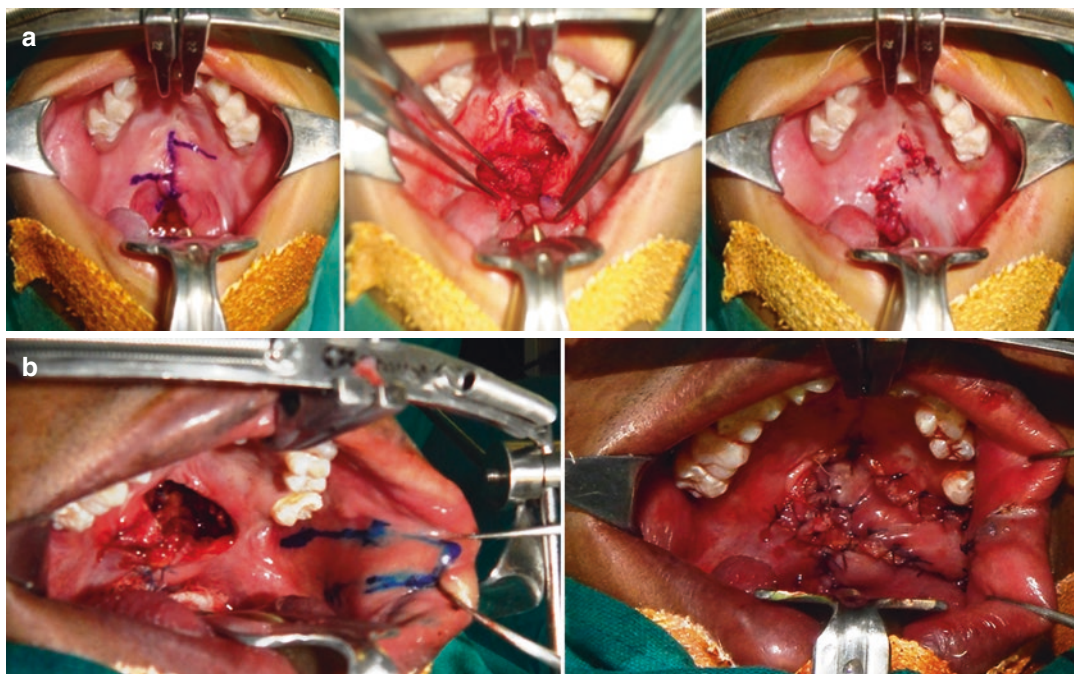


Fig. 1.16 (a) Modified Furlow's Z plasty. (b) Buccal myomucosal flap

and Trindade suggested that patients 6–12 years of age had better outcomes than their older counterparts [18]. Older children are unable to retrain their developed speech pattern after surgery. Surgeons and speech-language pathologists should counsel the patients and their parents on the increased risks associated with increasing age.

Maxillary Hypoplasia

Cleft lip and palate patients normally undergo surgical soft tissue repair of the cleft lip and palate during childhood. The resulting secondary deformities of the jaw and malocclusion are a consequence of early soft tissue repair of the cleft palate. It has been reported that 25–60% of cleft lip and palate patients need to undergo maxillary advancement to correct the resulting midface hypoplasia [19, 20]. Maxillary advancement in cleft lip and palate patients can be achieved using conventional Le Fort I osteotomy and rigid fixation or through distraction osteogenesis (DO). Each technique has its indications and advantages (Fig. 1.17).



Fig. 1.17 Maxillary hypoplasia

As a result of severe maxillary hypoplasia, the mandible often undergoes autorotation in anterior and superior direction with subsequent over closure of the vertical dimension and a loss of facial height, pseudoprogathism, and upward inclination of the occlusal plane.

How to Treat This Complication

It can be managed by orthognathic surgery and intraoral or extraoral distraction.

Maxillary advancement using conventional Le Fort I osteotomy is an accepted treatment modality for the treatment of cleft maxilla. It is performed as a single-stage surgical procedure but has a high relapse tendency. A significantly high relapse rates are noted in cleft patients than non-cleft patients.

Intraoral distraction osteogenesis is a successful alternative technique in maxillary advancement in patients with cleft lip and palate who need an advancement of less than 10 mm with stable posterior occlusion. It produces improvements in the skeletal and soft profile. Also intraoral distraction devices do not have any psychological impact and have longer consolidation phases.

Extraoral distraction devices, i.e., rigid distraction devices, allow large advancement of the underlying skeletal foundation with bony regeneration and soft tissue distraction histiogenesis. This gives better stability for large advancements with severe palatal scarring. Newly formed bone noted in the pterygoid region after maxillary distraction reduces the risk of relapse. A consolidation period of 3 months is a must in order to ensure and preserve the bony formation in the pterygoid region.

Recurrent Ear Infections

The middle ear function may not improve with palatoplasty. Cleft palate teams need to follow up all such children beginning at birth and going into adulthood, decades after a “successful” palate repair.

1.4.3 Complications Associated with Alveolar Bone Grafting Surgery

1.4.3.1 At the Recipient Site

Intraoperative Complications

Perforation of Nasal Layer

Nasal layer perforations can occur during dissecting the nasal layer from the palatal mucosa.

How to Treat This Complication

Perforations if small should be sutured with a resorbable suture. Large perforations require placement of collagen sheet depending on the perforation site.

Damage to the Tooth/Tooth bud

Damage to the tooth/tooth buds can occur during the dissection procedure and closure. Hence a careful approach is required to prevent damage to the tooth buds.

Postoperative Complications

Graft Exposure/Failure

It can occur due to:

- Improper oral hygiene leading to wound dehiscence
- Large intersegmental gap which causes increased tension on the mucosal closure over the bone graft, risking postoperative wound dehiscence (Fig. 1.18)

How to Avoid This Complication

A releasing mucosal incision or scoring of the periosteum should be done to avoid tension on the mucosal closure. A periodontal pack can be placed after the completion of suturing of the wound.

1.4.3.2 At the Donor Site (Anterior Iliac Crest)

Intraoperative Complications

Bleeding

Cancellous bone bleeding can be controlled by hemostatic agents like Gelfoam and Surgicel.



Fig. 1.18 Graft exposure

Fracture of Iliac Cortex

Fracture of iliac crest, a very unusual complication, has been reported in cases where there was injudicious use of osteotome and mallet leading to comminuted fracture and necessitating reduction and fixation.

Postoperative fracture is conservatively treated, with a period of bed rest followed by progressive ambulation. It is thought to mainly occur due to sudden contraction of the outer muscles in a weakened structure of the iliac crest.

Peritoneal Perforation

The use of a trephine to procure corticocancellous bone cores from the anterior iliac crest was found to carry a high risk of peritoneal perforation [21].

Injury to Inguinal Ligament

Inaccurate markings due to poor understanding of the anatomy and inadvertent use of curettes and bone gouges for removal of cancellous bone can cause inguinal ligament injury.

Injury to Ilioinguinal Nerve

The risk of nerve injury is significantly higher in cases in which graft deeper than 30 mm is harvested.

Postoperative Complications

Deep Hematoma

Hematoma formation results from inadequate intraoperative hemostasis, improper subperiosteal dissection, or cancellous bone bleeding. Significant deep hematomas have been reported when the layer-wise closure of the wound is improper. It can also occur due to strenuous activities post surgery. Water tight hermetic closure of Scarpa's fascia is required to prevent this complication.

Seroma

It is a collection of serous fluid that may develop after surgery in a dead space. The fluid contains blood plasma and inflammatory exudate which is derived from ruptured small blood vessels. Dead space elimination should be carried out with the help of external pressure dressing.

Infection and Wound Dehiscence

It can occur due to improper wound hygiene. Patient immunity and nutritional deficiency also play an important role in wound healing.

Meralgia Paresthetica

Meralgia paresthetica is described as a syndrome of dysesthesia or anesthesia in the distribution of the lateral femoral cutaneous nerve. Injury to the lateral femoral cutaneous nerve (Bernhardt's syndrome) or meralgia paresthetica occurs after harvest of the bone from the anterior iliac crest. The lateral femoral cutaneous nerve is a terminal sensory nerve that originates from L2 to L3 and innervates the skin of the thigh laterally.

How to Treat This Complication

Symptoms improve with occasional nerve blocks, analgesics, and desensitization. Some patients may require operative [decompression](#) or nerve sectioning.

Hernia

Herniation of the abdominal contents can occur through the donor site defect. Patients may present with lower abdominal pain and a sensation of fullness in the donor site. Computed tomography usually clearly shows the hernia.

How to Treat This Complication

Local tissue closure, Bosworth's method of crest resection and closure, rotation of regional fascial flaps, and the use of synthetic mesh grafts have all been suggested to treat these defects.

Gait Changes

For the morbidity of the donor site, the muscular attachments to the ilium play a significant role, when postoperative pain and gait disturbance are concerned. The reflection and retraction of the tensor fascia lata muscle seem to be the primary reasons for the increased morbidity observed with the anterior approach.

Foot Drop

It can occur due to peroneal nerve injury.