J. Int Oral Health 2011

P- ISSN
0976 – 7428

E- ISSN
0976 – 1799

Journal of International Oral Health

Orthodontics

Case Report

Received: June, 2011
Accepted: Oct, 2011

Bibliographic listing:
EBSCO Publishing
Database, Index
Copernicus, Genamics
Journalseek Database,
Proquest, Open J Gate.

Post burn deformity: A rare etiology for maxillo-facial disturbances and treatment strategy with team work

Prashantha SG* Silju Mathew† Mahendra P‡

*MDS, M Orth RCS (Edin), Reader, †MDS, Professor and Head, Department of Orthodontics, M.S.Ramaiah Dental College, ‡MDS, Reader, Department of Oral and Maxillo-facial surgery, Oxford Dental College, Bangalore, India. Contact: pacchi77@yahoo.com.

Abstract:
Post burn maxillo-mandibular deformities though rare still remain a cause of significant morbidity in children who sustain burns. Efforts for reconstruction should be directed not only at restoring satisfactory aesthetics but also at functional needs of patient. Best results may be obtained in patients treated properly and promptly by a team including plastic and maxillo-facial surgeons as well as orthodontists. Hence an attempt has been made here to present the management of these complex patients with various reconstructive options available.
Key words: Post burn deformity, Skeletal class III, Orthognathic surgery, Plastic surgery, Orthodontic treatment, Scar.

Introduction:

Relative contribution of hereditary and environmental factors for the etiology of skeletal maxillo-mandibular malrelations has been the subject of a number of previous studies.[1] Genetic mechanisms are clearly predominant during embryonic facial morphogenesis whereas environment is thought to take over post-natally, particularly during facial growth. Treatability followed by stability of any malocclusion including jaw discrepancies by means of orthodontic and orthognathic odalities lies in the ability to determination of etiology of malocclusion.[2]

Polygenic hypothesis and autosomal dominant trait have been proposed for heritability of maxillo-mandibular mal-relations whereas enlarged tonsils, nasal blockage, hormonal disturbances, endocrinal imbalances and trauma/disease involving premature loss of teeth have been suggested for the environmental factors. Soft tissue factors like lip/tongue activity and oral habits including digit sucking habit also listed under environmental causes.[1]

Maxillofacial disturbances in the form of skeletal class II (deficient mandible) following burns of the head and neck are more common in practice than the class III (protruded mandible).[3,4] There have been many articles pertaining to burns of the head and neck, mostly devoted to surgical and physiotherapeutic treatments and their results. However, only a few articles refer to the changes of the oro-maxillofacial structures caused by burns and their sequelae. A focus is especially on young children, where burn scars can exert a disastrous influence on the future growth and morphology of these structures[3]. Furthermore, these types of scars adversely affect a child's Physiological and psychological wellbeing during a crucial period of a child's physical and social development, leading to future psychosocial pathology.[4]

Though some information is available in the literature regarding post burn mandibular retrognathism (mandibular microstomia), hardly any information is available regarding mandibular prognathism (mandibular macrostomia) which is really a rare entity.

The purpose of this article, therefore, is to discuss the post burn deformity as a rare etiology for Maxillo-facial disturbances and clarify the role of the Orthodontist, Maxillo-facial surgeon and Plastic surgeon in the management of severe post-burn deformity.

Case history:

A 15 year old female was referred to the clinic of orthodontics by plastic surgeon after initial contracture release. She presented with severe mandibular prognathism and anterior open-bite deformity consequent upon deep hot cooking oil burns when she was 4 years old. She had been treated elsewhere conservatively earlier.

Clinical examination:

On extra-oral examination patient presented with concave profile and anterior divergence. Signs of contracture release were seen on the neck and lower face. Severe mandibular prognathism with drooling resulted from her inability to close the lips and the shallow lower anterior vestibule.

In intra-oral examination anterior openbite with severely proclained lower anterior dentition from the left lower first premolar to the right first lower premolar were noted. Oral hygiene was very much compromised. Molar relation was end-on bilaterally with spacing in lower arch and moderate crowding in upper arch seen. Anterior openbite was of the magnitude of around 9 mm with reverse overjet of around 13 mm. Mandible slightly shifted to right , with her midline deviated to right by around 3 mm.

Radiographic examination:

Tomograph was not very clear as too prognathic mandible could not be accommodated within the focal trough. Radiographs showed over retained deciduous canines in the lower arch, otherwise normal bone and dental development.

Cephalometric evaluation:

Steiner's analysis revealed orthognathic maxilla (SNA 80^0), relatively prognathic mandible (SNB 81^0) with class III skeletal pattern (ANB - 1^0). Proclained and forwardly placed lower incisors (75^0 and 18 mm to N-B line) and severe vertical growth pattern (SN-GoGN 49^0). (Table 1)

COGS (Burstone's analysis for orthognathic surgery) hard tissue analysis revealed anterior positioned mandible with curved chin, concave profile, retrognathic maxilla. The effective maxillary length is slightly decreased with increased mandibular body and decreased ramus height resulting for increased lower facial height

Fig 1 Extra-oral frontal photograph showing elongated face.

Fig 2 Extra-oral profile photograph wherein the scar contractures can be appreciated.

Fig 3 Extra-oral oblique photograph showing the mandibular prognathism.

Fig 4: Intra oral front, right and left photographs showing anterior openbite along with crossbite.

with severe vertical growth pattern. Class III skeletal pattern with retroclained upper and proclained lower anteriors. (Table 2)

Posterior maxillary and mandibular dental heights are increased suggesting the reason for anterior openbite.

Fig 5: Intra oral front, right and left photographs showing anterior openbite along with crossbite.

Fig 6: Intra oral front, right and left photographs showing anterior openbite along with crossbite.

Fig 7 Intra oral photograph showing upper occlusal view.

Fig 8 Intra oral photograph showing lower occlusal view where an additional premolar and the severity of incisor protrusion can be appreciated

Fig 9 Lateral cephalogram in occlusion

Model analysis:

Carey's (Arch perimeter) analysis revealed tooth material excess in maxillary arch by 4.54 mm

and in mandibular arch perimeter (arch size) is

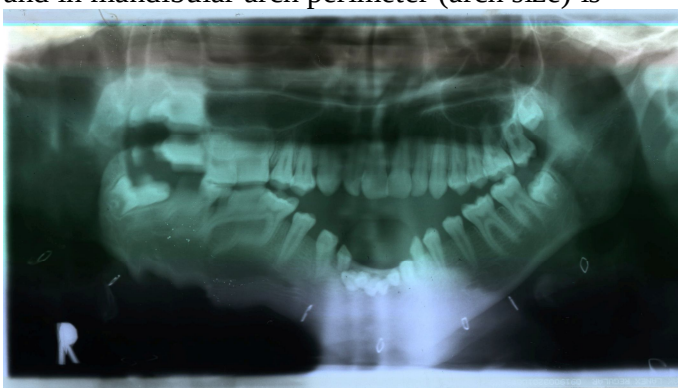

Fig 10 Orthopantomogram , where the view is distorted as whole mandible could not be placed inside the focal trough

excess by 10.61 mm. Bolton's analysis revealed mandibular tooth material excess in both overall ratio (1.2 mm) and anterior ratio (1.69 mm).

Treatment plan:

The proposed surgical and orthodontic program for the patient included: (I) Oral prophylaxis, (2) levelling and aligning of the teeth and creating space between the canine and the first premolar on both sides in the lower arch; (3) orthognathic surgery, consisting of bilateral sagittal split osteotomy mandibular setback, anterior sub-apical mandibular osteotomy and genioplasty.(4) Final contracture release by plastic surgeon.

Cephalometric examination in this patient showed that, in contradiction with the literature, there was protrusion of the chin profile and the rnandiblular bone growth had been stimulated by the scar contracture, in length as well as periostially. In certain patients these growth patterns influenced dental occlusion.

Pathophysiology:

Though the body surface area of the neck is small, burns to this area may cause significant Morbidity. Most of the significant neck burns heal with some element of burn scar contracture that restricts motion of the neck. There is a spectrum of severity associated with the restriction of neck mobility. Superficial partial-thickness burns may cause skin hyperpigmentation, neck tightness, or scar banding. Deeper burns will ultimately progress to scar contracture eventually causing secondary extrinsic contractures of the mobile features of the face in addition to restriction of neck motion. The growth and development of the mandible and spine may also become altered[4]. Early scar contractures involve the skin only. If neglected or treated inappropriately, they can progress to affect the muscle and skeleton secondarily. Therefore, severe postburn neck contractures may involve both soft tissue and bone, commonly resulting in mandibular retrusion and other deformities of the facial skeleton in growing individuals.[5]

The critical importance of the hyoid bone (located at the cervicomental angle) in the functional anatomy of the neck is very important to recognize. Muscles attached to the hyoid bone are important in both movement of the neck and in forming the contour of the neck. The suprahyoid region (submental subunit) is made up of the middle pharyngeal constrictor muscle, hypoglossus muscle, digastric muscle, stylohoid muscle, geniohoid muscle, myloid muscle, and genioglossus muscle. Below the hyoid bone are the thyroid muscle, omohoid muscle, sternohyoid muscle. Together with sternoclaidomastoid and muscles of the posterior triangle, these muscles are important for the function of the neck and in forming the contour of the neck from the chin to the cervicomental angle to sternal notch. The hyoiod bone is at the turning point of this neck contour and this forms the cervicomental angle.It is not only important for aesthetics of the neck, it is also the pivot point for movement of the neck.[5]

The neck skin is relatively thin (0.5– 0.7 cm), mobile, and elastic. The neck has several horizontal skin creases that are related to its function of flexion, extension, and rotation. After severe burns, the neck forms scar contractures very easily. These Contractures cause the chin and neck to become scarred to the chest. As a result, the cervicomental angle is lost and the natural curvature of the neck is disrupted. Flexion and extension of the neck pivoted on the hyoid bone is hence severely limited. In the most severe cases, the entire neck is fixed and immobilized[5].

The functional matrix theory of cranio-facial growth control hypothesizes that adult

cranio-facial bony architecture is a precise adaptation to the soft tissue conditions in which it develops. The physiological and bio-mechanical

STEINER'S ANALYSIS			
	Patient Value	Mean	S D
SNA ^{0}	80^0	82.0	3.5
SNB ^{0}	81^0	80.0	3.0
ANB ^{0}	-1^0	2.0	2.4
U1-NA (mm)	4 mm	4.3	2.7
U1-NA (^{0})	26^0	22.8	5.7
L1-NB (mm)	18 mm	4.0	1.8
L1-NB (^{0})	75^0	25.3	6.0
Pog-NB (mm)		2.4	1.7
Po & L1 - NB Diff (mm)		2.6	1.7
Interincisal Ang (U1-L1 ^{0})	80^0	130.0	5.0
Occ Plane to SN (^{0})	34^0	14.4	2.5
SN - GoGn (^{0})	50^0	32.9	5.2

equilibrium that exists between the growing cranio-facial skeleton and the surrounding soft tissue produces a custom fit bony complex according to Moss.[6] As explained by Melvin Moss in his classic article, the mandibular growth is a combination of morphologic effect of both capsular and periosteal matrices. Any abnormality of oro-facial capsular matrix can have a adverse effect on the growing oro-facial complex.[7] The deforming forces of scar contracture associated with neglected burns of paediatric head and neck region logically represents one such potential soft tissue influence on the final facial skeletal form.[6]

Probable adjunctive treatment modalities:

Release of Neck Contracture

Excision of scars and release of neck contractures allow for optimal reconstruction of the neck by exposure of the cervicomental angle. The techniques used for contracture excision and/or release may vary based on subunit area. Scars involving the lower lip/chin subunit should be excised entirely to obtain correct eversion of the lower lip. In the submental area, the emphasis is on releasing the contractures rather than completely excising them. In the anterior neck subunit, all scars and normal skin should be excised as a single unit.[5]

COGS ANALYSIS			
	Patient Value	Mean	S D
Cranial base			
Ar-PTM (HP) (mm)		32.8	1.9
PTM-N (HP) (mm)		50.9	3.0
Horizontal (skeletal)			
N-A-Pg (^{0})		2.6	5.1
N-A (HP) (mm)		-2.0	3.7
N-B (HP) (mm)		-6.9	4.3
N-Pg (HP) (mm)		-6.5	5.1
Vertical (skeletal, dental)			
SN-ANS (perp HP) (mm)		50.0	2.4
ANS-Me (perp HP) (mm)		60.6	3.5
PNS-N (perp HP) (mm)		50.6	2.2
Mand Plane - HP (^{0})		24.2	5.0
U1 - NF (perp NF) (mm)		27.5	1.7
L1 - MP (perp MP) (mm)		40.8	1.8
U6 - NF (perp NF) (mm)		23.0	1.3
L6 - MP (perp MP) (mm)		32.1	1.9
Maxilla, mandible			
PNS-ANS (HP) (mm)		52.6	3.5
Ar - Go (mm)		46.8	2.5
Go - Pg (mm)		74.3	5.8
B-Pg (MP) (mm)		7.2	1.9
Ar-Go-Gn (^{0})		122.0	6.9
Dental			
OP - HP (^{0})		7.1	2.5
A-B (OP) (mm)		0.4	2.5
U1 - NF (^{0})		112.5	5.3
L1 - GoGn (^{0})		95.9	5.7

Complete release of neck contracture and excision of tissues should proceed past the midaxial plane on both sides. The edges should be either zigzagged or fishtailed to prevent recurrence. The contracted platysma muscle should be incised transversely at the level of the hyoid bone, and the release should be extended down to the hyoid bone. To expose the cervicomental angle and restore full range of motion of the neck, the

fibrosed suprahyoid muscles occasionally need to be partially divided.[5]

Platysmaplasty

The platysma is the most severely affected muscle in neck contractures because it is in close proximity to the skin and it is very thin. In cases of recurrent neck contracture, most had not undergone platysmaplasty as part of the initial operation. The authors feel that if platysmaplasty is not performed as part of the initial operation, the rate of recurrent contracture will approach 100%. Therefore, platysmaplasty to be performed in almost all of cases.[5]

First, the platysma muscle is aggressively debrided and all areas of scar and fibrosis are excised. The remaining muscle is then incised transversely at the level of the hyoid bone. This release should be extended down to the hyoid bone, leaving a superior and an inferior strip of platysma. The superior strip of platysma (between the mandibular angles) is elevated to the lower border of mandible. The muscle is then folded over itself and sutured to the anterior border of the mandible. In addition to releasing deep contractures and preventing recurrence, this technique serves to augment the chin and to deepen the cervicomental angle.[5]

Resurfacing the Wound

There are several surgical options for resurfacing the neck after release of contractures like skin grafts and flaps. But in this case tissue expanders are preferred because of following reasons.

Tissue expanders

The Tissue Expander (TE) is a versatile addition to the armamentarium of the burn reconstructive surgeon. This technique allows the surgeon to expand surrounding skin with appropriate color match, texture and minimize donor site deformity.[8]

Tissue expansion techniques have proven particularly useful in the compliant tissue of the neck, offering an alternative to skin grafting and often yielding superior aesthetic results.[8]

This method gives acceptable results using the expanded occipito-cervico-pectoral (o-c-p) flap complications such as flap loss, hematoma, seroma, infection[8].

Postoperative Care

Patients should wear the appropriate neck braces and splints for at least 6 months to prevent recurrence of the neck contracture. Topical silicone sheeting is also useful in preventing scar formation and contracture recurrence. Minor revisions such as flap debulking, scar revision, and z-plasty are often indicated as secondary procedures.[5]

Orthodontics and Orthognathic surgery (Body osteotomy):

Orthodontic leveling and aligning of maxillary and mandibular teeth in order to facilitate mandibular setback with Orthognathic surgical procedure is recommended. Preferable to use 0.022 PEA mechanics with 0.019x0.025 ss as it can give rigidity required for inter-maxillary fixation during surgery. Mandibular body osteotomy with 'v' shaped wedge removal is recommended procedure for mandibular set back as well as rotation of anterior part of mandible upwards. For this an additional premolars will be extracted and space should be concentrated at premolar area. Routine Bilateral mandibular sagittal split osteotomy is not recommended in this case as molars are more or less in class I relation and anterior part of the mandible is deflected downward.[10,11] Though more risk is involved in body osteotomy in terms of exposure of inferior alveolar nerve, in this condition it has better-edge over conventional bilateral sagittal split osteotomy.[6]

Second phase of surgery:

In second phase, restoration of mento-labial sulcus and genioplasty should be considered based on the outcome of first phase of treatment. This should be carried out after 3-6 months giving sufficient time for bony union and restoration of vascularity of surgical site.

Restoration of mento-labial sulcus:

This procedure is to be carried out only when the scars have matured sufficiently. A complete release of the contracture down to the normal tissue is obtained without disturbing the normal healthy tissue. Fine scissor dissection is carried out to release the intricate fibrosis in the involved tissue. Excess scar tissue is excised where

indicated. The mento-labial sulcus is usually situated at the junction upper one-third and lower two-thirds of lip-chin complex. The junction is marked on the lip after the release of contracture. A full thickness horizontal rectangle (excluding mucous membrane) of 1.5x1 cm is excised from the lip in the midline of the above marked line. The defect is repaired by advancing the flaps from the sides of the rectangular defect as shown in the fig. The dimention of the rectangle may vary to suit individual needs. Skin cover is provided by full thickness skin graft from postauricular or supraclavicular region. Whenever possible a local advancement flap is used to cover the defect in the region of the recreated sulcus. Pressure compression is used over the graft for a minimum of 3-4 months.[9]

Genioplasty

In patients presented with neck burns that occurred during childhood and were neglected or inadequately treated, the neck contractures restrict growth and cause retrusion of the chin. Portions of the suprahyoid muscles become fibrosed, and, hence, the cervicomental angle cannot be fully restored, even after full release of the contractures and platysmaplasty[5].

Therefore, these patients benefit from a sliding genioplasty to advance the chin and restore the natural contour of the neck. After exposing the lower border of the mandible with the platysmaplasty approach, a subperiosteal dissection is performed up to the level of the mandibular groove. A transverse osteotomy is then performed 0.5 cm below the level of the mental foramina. Care must be taken not to disrupt the mental nerve and the muscles attached to the bony segment. The bone is then advanced between 6 and 10 mm and fixed with a titanium plate. Genioplasty lengthens the distance between the pogonion (tip of the chin) and the hyoid bone (the submental subunit) to at least 3 cm, and thus helps to create the cervicomental angle.[5]

Conclusion:

Morbidity because of post burn neck and lower face deformity is a major concern. Restoration of functional needs is as important as cosmetic reconstruction. Proper protocol for the management of post burn neck and face deformity including various specialties should be framed as in case of clefts.

References:

1. P A Mossey. The heritability of malocclusion: Part 2.The influence of genetics in malocclusion. BJO.1999; 26(3): 195-203.
2. P A Mossey. The heritability of malocclusion: Part 1.Genetics, Principles and Terminology. BJO. 1999; 26(2): 103-13.
3. 0 Nahlieli, J P Kelly, A M Baruchin, P Ben-Meir, Y Shapira. Oro-maxillofacial skeletal deformities resulting from burn scar contractures of the face and neck. Burns. 1995; 21(1): 65-9.
4. Mark A Grevious, Karina Paulius, Lawrence J Gottlieb. Burn Scar Contractures of the Pediatric Neck. The Journal of Craniofacial Surgery. 2008; 19 (4): 1010-15.
5. Yi Xin Zhang et al. A Treatment Strategy for Postburn Neck Reconstruction, Emphasizing the Functional and Aesthetic Importance of the Cervicomental Angle. Annals of Plastic Surgery. December 2010; 65(6): 528-34.
6. J Katasaros, D J David, P A Griffin, M H Moore. Facial dysmorphology in the neglected paediatric head and nec k burn. British Journal of Plastic Surgery. 1990; 43: 232-35.
7. Melvin L Moss, Letty Salentijn. The primary role of functional matrices in facial growth. Am. J.Orthodontics. 1969; 55(6): 566-77.
8. S Motameda, A J Kalantar Hormozi, S Marzban. Expanded occipito-cervico-pectoral flap for reconstruction of burned cervical contracture. Burns 2003; 29: 842-44.
9. E R L Cardosa, H S Amonoo-Kuofi, M B Harwary. Post burn deformity lip-chin complex: A method to restore mento-labial sulcus, Int J. Oral Maxillofac Surgery, 1995; 24: 148-50.
10. Proffit W R, White R P, Sarver D M. Contemporary treatment of Dentfacial Mosby, 2002;331-33.

11. Raymond J Fonseca. Oral & Maxillofacial surgery- Orthognathic surgery: Saunders, 2000: 329-42.

Source of Support: Nil

Conflict of Interest: No Financial Conflict