Acta Scientific Dental Sciences (ISSN: 2581-4893)

Volume 5 Issue 6 June 2021

Literature Review

Craniofacial Distraction Osteogenesis - An Overview and Review of Literature

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Received: March 29, 2021

Published: May 05, 2021

Abstract

Distraction osteogenesis is a reliable method for regeneration of bone deficiency, used in treatment velopharyngeal incompetence, and other craniofacial disorders. Extraoral and intraoral devices have been developed to aid in distraction of facial bones. Blood supply preservation, stable fixation and distraction of bones is key to its success. Further study and research need to be undertaken for implementation of distraction osteogenesis in clinical use for various craniofacial deformities.

Keywords: Distraction Osteogenesis; Craniofacial; Blood Supply; Stable Fixation

Introduction

Distraction osteogenesis is a technique of creating bone for treatment of craniofacial anomalies [1]. Distraction osteogenesis helps in formation of new bone between a defect in skeleton [2]. It is a novel technique for reconstruction of bone in conditions where conventional techniques have high chance of failure. As clinicians begin applying this new technique, they will quickly realize that there is learning curve associated with distraction osteogenesis to treat deformities of the head and neck.

Historical Background

Hipocrates was the first person in history to describe bone healing. Codivilla was an Italian surgeon who first reported on distraction osteogenesis. Ilizarov used modular ring fixator in his practise. This treatment was successful in russian patients. He used this technique to heal nonunion in bone by using distraction osteogenesis [3]. Synder did the first distraction osteogenesis on mandible. McCarthy did the first distraction osteogenesis for congenital anomalies [4].

Biomechanism of distraction osteogenesis

Reparative callus is formed in distraction osteogenesis. New bone is formed by the callus under tension by stretching. There are four stages in distraction osteogenesis. First stage is osteotomy followed by latency, distraction and consolidation.

Review of Literature

Chin and Toth had done a study to show the feasibility of distraction osteogenesis in correcting maxillofacial skeletal deformities using internal devices in five patients. They had performed the first case of alveolar distraction in humans when they treated one female patient with distraction of the anterior mandible after she acquired

the defect due to the avulsion of tooth in road traffic accident [5]. Dental crowding was treated by distraction by Bell., *et al*. The study concluded that Distraction osteogenesis provided an alternative to orthognathic surgery for widening the mandible [6]. Oda T., *et al*. had performed vertical alveolar distraction and he demonstrated the development of new bone in the distraction area [7]. Fukuda., *et al.* used distraction osteogenesis for reconstruction after mandibular segmental resection [8]. K.A Alruhaimi had demonstrated current protocol for distraction osteogenesis in rabbit mandible [9]. Clemens N Klug described the use of guided bone regeneration in distraction osteogenesis [10]. Abel Garcia Garcia., *et al*. had done study on four patients and shown that in cases of vertical distraction of relatively long transport segments (greater than 2 cm), the use of two distractors, one at each end eliminates the possibility of longitudinal tilting [11]. M Robiony., *et al*. had performed distraction osteogenesis for severely atrophic mandible in five patients [12]. PJ van Strijen., *et al*. evaluated complications (intraoperative, intra distraction, and post distraction) retrospectively. He concluded distraction osteogenesis to be a safe procedure [13]. Enislidis., *et al*. had reported augmentation of atrophic edentulous mandibles by distraction osteogenesis [14]. E M Bass., *et al*. evaluated neurosensory disturbance between BSSO and distraction osteogenesis. The study found equal chance of neurosensory disturbance in both [15].

Future Directions

Because biological and biomechanical factors play such a critical role in the successful application of osteodistraction, the main thrust of current and future investigations will focus on these areas in particular. Osteotomy is the most important part of distraction osteogenesis. Improvements in osteotomy techniques should proceed toward a division of bone without disruption of the periosteum, endosteum, or neurovascular bundle within the medullary canal. This is particularly important at sites with insufficient host bone at the ends of the osteotomized segments, as is the case with bone cuts between teeth. Future directions in the development of an ideal distraction device should proceed toward a multi-directional intraoral appliance with the capability of simultaneous linear and angular adjustments. Preoperative planning of surgical procedures for craniofacial reconstruction, particularly with the dynamic process of gradual distraction, requires analysis of data gathered from clinical examination, dental models and cephalometric measurements [16]. Exact anatomical reconstruction is facilitated by computer assisted 3-D planning. Computer based processing of multidimensional medical image data has excellent interactive functionality and allows clear visualization of the hard tissues and soft tissues without obscuration from the overlying skin [16]. An alternative simulation technique incorporates the use of stereolithographic models into treatment planning. This technique allows the placement of distraction devices onto the three-dimensional model for accurate simulation of the distraction vector.

Conclusion

Different devices extraoral and intraoral that provide stable fixation can propagate distraction osteogenesis and therefore allow for creative applications to areas such as the facial bones the advantage of distraction osteogenesis is lengthening of bone and soft tissue, no donor site morbidity, low infection rate, less operating time, less invasive and avoidance of bone grafts. However, this process has some disadvantages like damage to tooth germ, bilateral coronoid ankylosis, skin scars if used extraorally, adaptability of surrounding soft tissues and changes in TMJ. Further study and research need to be undertaken for implementation of distraction osteogenesis in clinical use for various craniofacial deformities.

Conflict of Interest

No conflict of interest.

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