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The Role of Stem Cells in Reconstruction of Facial Skeleton

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Abstract

Role of mesenchymal stem cells were used for reconstruction of the Facial Skeleton. Stem cells were found in embryonic stages, formation and healing of bone grafting, distraction for elongation of short limbs in children in cases of poliomyelitis. Stem cells were played an important role in cancer therapy and shown promising in unimodality effect that could revolutionized cancer therapy. Stem cells in maxilla-facial surgery played and focuses on repairing hard and soft tissue. There was significant loss of trauma, missile war injuries, pathological lesion effecting the mandible and developmental deformities. Oral cancer was been played an important role in development or therapeutic effect and regenerative therapy. Series of cases were treated and reported like shell injuries to the face, traumatic traffic accident with severe damages to both roofs of the orbits with fracture anterior cranial fossa were treated by bone grafts. Intra uterine trauma to female child borne with ankylosis of the TMJ and First Arch dysplasia or hemifacial microsomia, were treated by Kummoona Chondr-Osseous graft for restoration of function and growth of the mandible and midface.

Keywords: Stem Cells; Regeneration; Reconstruction; Bone Graft; Distraction; Chondro-Osseous Graft; Cancer Therapy

Introduction

The aim of this research and studies to evaluate the role of mesenchymal stem cells, played transformative role in reconstruction of the facial skeleton and managements of oral cancer as therapeutic agent by promoting bone and soft tissue regeneration. Stem cells defined an organism that can develop into many types of cells during early life and growth and serve as repair system and play a great role in regenerative medicine. The facial skeleton consisting from fifty small bones articulate as a pyramid. These small cells forming the charisma of the person and the face itself carry the features of bountifulness, dullness and smart and stupidness. The face also carries the signs of disease like, paleness due to anemias, puffy face due to kidney disease and heart failure and redness might carry blood disease and loss of wight with paleness of the face might the patient feature serious disease like cancer. The facial skeleton might be subjected to RTA or to missile war injuries creating sever deformities of the face might associated with multiple injuries and loss of conscious due to head injuries [1] (Figure 1 (A),(B) & Figure 2(A-C)).

Malformation of congenital disease like First Arch Syndrome or traumatic injuries. to temporomandibular joint (TMJ) causing ankylosis of the joint with deformities and loss of function in both adult and children. Also, cancer of orofacial region constitutes about 4% of total cancer. Bone grafting and Distraction should not be forgot in. (Figure 1 (A),(B) & Figure 2(A-C)) All these cases required mesenchymal stem cells during development, healing process in bone graft and destruction required reconstruction of soft tissues and bones. The mesenchymal stem cells were used in regenerative medicine focusing in repairing both soft tissue and hard tissue were required varieties of flaps and bone grafting harvested from iliac crest might resulting morbidity. These types of surgery was a great challenge to the surgeons and may face psychologically suffering of the patients. This status required tissue engineering for reconstruction in different sites of Cranio-maxillo-facial regions. Stem cells play now days an important role TMJ surgery, bone grafting, chondro-osseous graft for TMJ growth and function and elongation of limbs children were suffering from poliomyelitis [2].

Materials, Result and Methods

Series of cases were involved in these managements of cases including young adults and children of males and females. The cases enrolled in this study were suffering from previous trauma of road traffic accident like TMJ ankylosis, congenital malformation like first arch syndrome and hypoplasia of the condyle (Figure 3(A),(B)). Ankylosis is the most insult disease to human body due

to traumatic injuries to the TMJ both in children and young adults. Experimental studied on young Rabbits of 3 months of age and terminated in 3 months also and the aim were to [1];

a) Prove the condyle carry a growth center first was reported by (John Hunter 1772-73). We did our experiment by excision the head of condyle , three months after termination of the Rabbits, we observed sever deformity of the jaw Rabbit in the effected side.

b) After resection of the Rabbits condyle, we did reconstruct the TMJ by chondro-osseous graft to restore the normal biological function of growth, remodeling and repair [3-5].

c) Specimens of the resected chondro-osseous graft that replaced the resected condyle and TMJ, the specimens were immersed in buffer formalin of 10% with decalcified material for two weeks, slide prepared and stained by Hematoxylin-Eosin (H&E), to study the cytological changes of the chondro-osseous graft that occurred after transferred from iliac crest as wight bearing to new functional activity of masticatory process of the new TMJ created and advocated by Kummoona Chondro-Osseous Graft [6-13].

d) The aim of our experiment in Rabbits to study the viability of bone graft. Also, the value of Distraction osteogenesis for managements of leg with poliomyelitis o children and advance jaw deformity.

Figure 1A: A twenty-six years young man with missile shell injuries to the right side of the upper and lower lips with the angle.

Figure 1B: Two years of post-operative photo after immediate reconstruction by rotation flaps.

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Figure 2A: 18 years female with severe injuries of frontal bone and fracture of roof of the orbits and fracture of anterior cranial fossa and tearing of Dura and CSF leakage.

Figure 2B: Immediate post-operative photo after craniotomy by bi coronal flap, reconstruction of Dura by galea as water tight and reconstruction of anterior cranial fossa, roof of both orbit and frontal bone by bone graft and Sialastic.

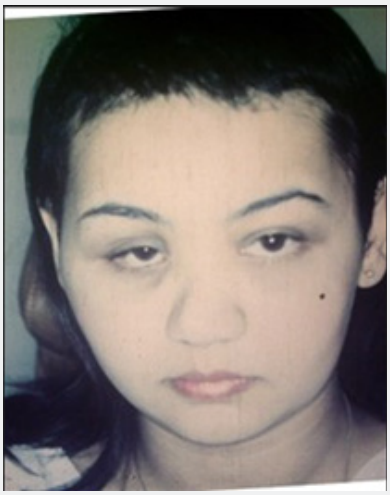

Figure 2C: Six months of post-operative photo.

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Figure 3A: Severe deformity and under developed with loss of growth of the mandible of 5 years female child with fix joint and ankylosis of the left side of TMJ due to intra uterine trauma.

Figure 3B: One year's post operative photo with remarkable growth of the mandible and midface after reconstruction of the left TMJ by Kummoona Chondro-Osseous graft.

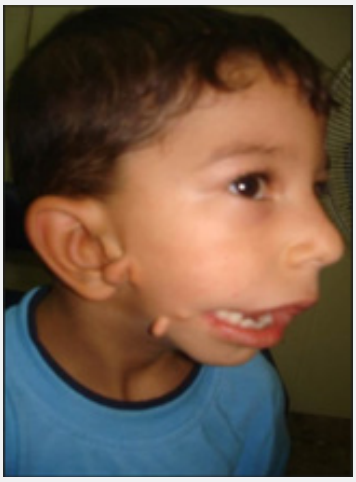

Figure 4A: First arch Syndrome or hemifacial microsomia of right side of the face of 4 years child with large cleft of the angle, deformity of the ear and tags with underdeveloped mandible.

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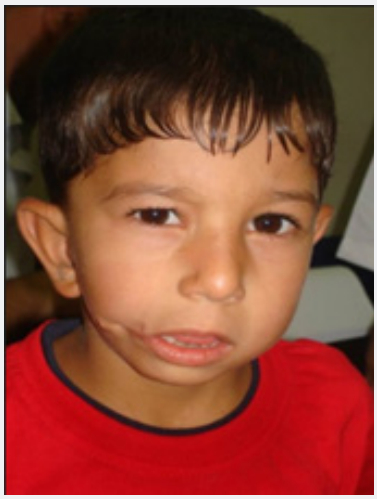

Figure 4B: Two years post -operative photo after series of operations with reconstruction of the TMJ by Kummoona chondro-osseous graft.

Figure 5A: New borne female with First arch syndrome was miss treated by under developed distractor.

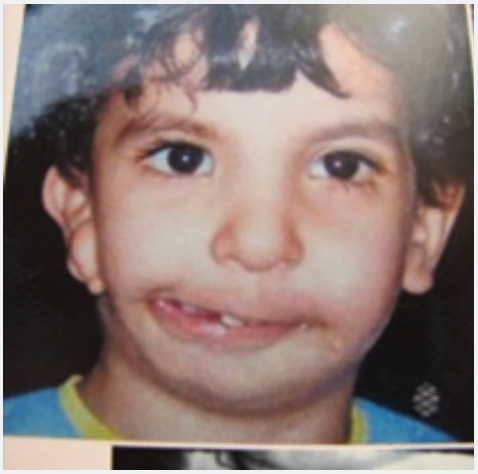

Figure 5B: The same female child, age 4 years with obvious first arch syndrome.

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Figure 5C: Three-dimension CT scan showing missing glenoid fossa, zygomatic root of temporal bone, TMJ and upper part of ascending ramus.

Figure 5D: Same female at age of 7 years after series of operations, photo of the face.

Histopathology

We found during examination of the chondro-osseous graft by microscope with staining by (H&E) [4]; distinct layers were notice. The first layer consisting from thick fibrocartilage layer, it was thick because the hard food, the second layer consisting from several layers of round mesenchymal stem cells (growth layer), the third layer consisting from chondrocyte with series of hypertrophic layer and the fourth layer consist from osteoid tissue and bone marrow in between.

Histopathology of bone graft and distraction osteogenesis

Cytological and histopathological studies was quiet interesting started by formation of aggregation of plat lets as clot with liberation of platelets growth factor (PGF), and healthy granulation tissue, fine small vessels invading the graft and bone to grafted by creeping mechanism, mesenchymal stem cells were derived from bone marrow of the stump, periosteum and overlying muscles, with formation of large number of fibroblasts and tiny small vessels. Osteoid tissue and chondrocyte also seen. The cellular changes of distraction technique and bone grafting by inducing mesenchymal stem cells are the same in both bone grafting and distraction except distraction induced by osteotomy with stretching growth potential of bone based on Illizarov theory and bone grafting is based on decortication of both graft and stump of bone [4,5].

Discussion

This research with our clinical studies of role of mesenchymal stem cells in growth and reconstruction. Stem cells proved to be a revolution in engineering of reconstructive surgery of the facial skeleton. Tissue engineering was joined with medicine 1987

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and it was the key point in tissue engineering by work of few doctors from Bosten and MIT and the wide benefit from tissue engineering are reduction of donor site and morbidity [13]. Also decrease in the procedure sensitivity of repaid and the capacity intimately adapt in vivo tissue environment into recapitulate normal craniofacial development. Stem cell plays a role in its effect in cancer therapy. It's does show promising an uno modulatory effect that could revolutionize cancer therapy and treatment modality [3]. Stem cells play an important role in healing of bone grafting and distraction of bone. Stem cell also played in growth of jaws and the TMJ that was replaced by chondro-osseous graft for managements and fore replaced damaged joint in ankylosis. The chondro-osseous also been used for managements and reconstruction of the hypoplasia of the condyle and First Arch Syndrome.

The recent work in Oral cancer was able to modulate immune responses by reducing inflammation and enhancing the immune system against cancer cell and further to that the researcher been able to enhance the immune system against cancer cell and promoting tissue repair and might reduce the cancer recurrence [3]. It was found that stem cell had the ability to suppress the activities of immune cell that been able to promote cancer cell that attack cancer cell. Recently the work in engineering medicine that stem cell can attack cancer by making anti-tumor agent and targeting the cancer cell. Stem cells derived from mesenchymal tissues of bone marrow; we notice and found there are strong relation between the bone graft and distraction osteogenesis. Stem cells were derived from bone marrow, periosteum and overlying muscles. Growth factor released from platelets (PGF). Stem cells play an important role in reconstructed Kummoona Chondro-Osseous graft in growth, repair and remodeling of the TMJ.

Furthermore, observation on stem cells were an important factor in bone grafting and distraction of bone for managements of short limb due to poliomyelitis based on theory created by Illizarov of Russia. The TMJ reconstruction was a great challenge to all craniomaxillofacial surgeons for the last 6 decades. The biological reconstruction of the TMJ damaged disease such as damaged TMJ in ankylosed joint or missing or under developed one. In cassis of First Arch dysplasia syndrome due to early occlusion of Stape dial artery, the main nutrient vessel to the First and Second branchial arches in the embryonic development (Figure 4(A),(B) & Figure 5(A-D)). Ankylosis of the TMJ is a serious crippling disease with stiff joint effect children due to traumatic injury to the TMJ in road traffic accident or fall from Hight with intra capsular fracture with fragmentation of the disc of the condyle. Miss treatment led to ankylosis.

The child complained from un ability to open or close the mouth with difficulty in chewing food, swallowing or speech. The consequences of this disease are damage to growth center in the condyle and effect on growth of the mandible and midface. Clinically the disease featured in three forms of First Arch dysplasia Syndrome (hemifacial microsomia) milled, moderate and sever form of the disease. The milled form appeared with under developed mandible and presence of tags in the preauricular area as remanent of Meckel's cartilage. The moderate type featured as cleft in the angle of the mouth, underdeveloped masseter muscle, missing condyle, ear deformity and deficiency in growth of the mandible and midface. The severe form of the disease is very wide cleft of the angle of the mouth with partial or complete loss of the ear, missing of temporomandibular joint (TMJ), absence of glenoid fossa and zygomatic root of temporal bone, with missing upper part of ascending ramus with underdeveloped mandible and midface. Kummoona Chondro-Osseous graft with presence of mesenchymal stem cells from iliac crest was used for reconstruction of the TMJ in children for restoring growth of the mandible and midface after correction of angle of the mouth by commissuroplasty and cartilage graft for building the glenoid fossa and bone graft for reconstruction of the zygomatic root of temporal bone. This series of operation should be carried out before the child go to school.

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