International Journal of Early Childhood Special Education (INT-JECSE)
DOI:10.9756/INTJECSE/V14I5.647 ISSN: 1308-5581 Vol 14, Issue 05 2022

ORTHOGNATHIC PROCEDURES AS AID TO ORAL REHABILITATION

- **J.S Thaslima Nandhini**

Undergraduate student Saveetha Dental college and Hospitals,Saveetha Institute of Medical and Technical Sciences,Saveetha University, Chennai-77-77.

- **Dr. Madhulaxmi M***

Professor, Senior lecturer,Department of Oral And maxillofacial surgery, Saveetha Dental college and Hospitals,Saveetha Institute of Medical and Technical Sciences,Saveetha University, Chennai-77-77.

Abstract

Background - Orthognathic surgery is a surgery designed to correct conditions of the jaw and lower face related to growth, airway issues including sleep apnea, TMJ disorders, malocclusion problems primarily arising from skeletal deformities, other orthodontic dental bite problems that cannot be easily treated with braces, as well as the broad range of facial imbalances, disharmonies, deformities, asymmetries and malproportions were correction can be considered to improve facial aesthetics and self esteem

Materials and methods - All the cases reported for orthognathic surgery between June 2020 and February 2021 were considered in this study. The details of patients who underwent orthognathic surgery for oral rehabilitation and esthetics were retrieved from dental information archiving systems. The data obtained was recorded in excel and subjected to statistical analysis.

Results - A total number of 70 patients had undergone orthognathic procedures during the study period. Orthognathic surgery is most commonly done among males than females and done in both arches. Functional reason is most commonly done for prosthesis and in the age group of 46-60 years of age. 10% of the study population had orthognathic surgery for functional reasons. The rest were all for esthetic reasons and in the age group of 15-30.

Conclusion Within the limitations of study, it is concluded that orthognathic surgery can be successfully used for aiding in management of prosthetic rehabilitation, airway management and TMJ deformities. This also confers that OGS is not a procedure limited to the young population alone and can be used for older age groups when needed with positive outcome.

Keywords: orthognathic surgery, oral rehabilitation, functional, esthetics, orthodontics, jaw surgery, innovative technique.

Introduction:

Achieving satisfactory results in the treatment of complex cases requires a multidisciplinary approach that allows the personal therapeutic limits of each party involved in the treatment plan to be extended.[1] Orthognathic surgery, therefore allow us to overcome the challenges associated with orthodontics, such as loss of anchorage in cases of multiple edentulous spaces, restricted alveolar compensation, and of conventional prostheses, such as the impossibility of correcting gaps that are too large, midline shifts, open bite, overbite, overjet or misalignment of the prosthetic axes.[2] The objective of orthognathic surgery is to correct maxillomandibular deformities or dysmorphism, whether they are congenital or acquired. Comprehensive oral rehabilitation.[3][4]

Orthognathic surgery also called as corrective jaw surgery or simply jaw surgery, it is a surgery designed to correct conditions of the jaw and lower face related to growth, airway issues, structures including sleep apnea, TMJ disorders, malocclusion problems primarily arising from skeletal deformities, other orthodontic dental bite problems that cannot be easily treated with braces, as well as the broad range of facial imbalances, disharmonies, deformities, asymmetries and malproportions were correction can be considered to improve facial aesthetics[5] and self esteem.[6] The jaw osteotomy, either to the upper jaw or lower jaw, requires an oral and maxillofacial surgeon to surgically align an arch of teeth,[7] or the segment of a dental arch with its associated bone, relative to other segments of the dental arches.[8] Working with orthodontists, the coordination of dental arches has primarily been directed to create a working occlusion.[9] orthognathic surgery is seen as a secondary procedure supporting a more fundamental orthodontic objective.[10][11] It is only recently, and especially with the evolution of oral and maxillofacial surgery in establishing itself as a primary medical specialty as opposed to its long term status as a dental speciality that orthognathic surgery has increasingly emerged as a primary treatment for obstructive sleep apnoea, as well as for primary facial proportionality or symmetry correction[12][13]. Our team has extensive knowledge and research experience that has translate into high quality publications[2],[14],[15],[16],[17–26][27],[28–30].[31,32] The aim of the study was to access orthognathic surgery procedures as aid to oral rehabilitation.

Materials and methods:
This is a retrospective study done in an institutional set up in India. The data of all patients who visited the institution between June 2020 and February 2021 were reviewed and analysed. These data were cross verified with photographs. Among a sample data of 69 patients who had undergone OGS, n=70 patients were finally included by inclusion criteria (orthognathic surgery in non syndromic patients) and exclusion criteria (Treatment of patients with syndromes; cleft lip or palate treatment or both). Data collected with following parameters age and gender. Approval of the ethical committee was taken before the start of the study. Records of total number of patients who underwent orthognathic surgery between June 2020 - February 2021. Information regarding the reason for orthognathic surgery, oral rehabilitation in outcome were analysed. Data were analysed using SPSS statistical software . Data analyses done using chi square test . P value was set as 0.05 as level of significance.

Results
Out of the total number of orthognathic surgery. Most common age group to have orthognathic surgery is 15-30 years (91%) followed by 31-45 years (5%) and 46-60 (4%) (graph 1) Males (53%) are most common to have orthognathic surgery, when compared to female (46%) population in this study group (graph 2). 49% of orthognathic surgery was done in both arches and then lower arch (31%) followed by upper arch (18%)(graph 3). Orthognathic surgery is most commonly done for aesthetic reasons (90%) (graph 4) and commonly done for the age group between 15-30 years of age (graph 5). However, a reasonable number of patients in both genders underwent OGS for functional purposes including TMJ disorders (n = 2) and prosthetic rehabilitation (n = 5) (graph 6 & 7).

Legends:
Graph 1: Bar graph showing a frequency distribution of the age group who underwent orthognathic surgery. X axis shows age group and Y axis shows percentage of patients with orthognathic surgery. Purple colour represents 15-30 years, red colour represents 31-45 years and green colour represents 46-60 years.

Graph 2: Bar graph shows a frequency distribution of gender who underwent orthognathic surgery. Males are more prone to have orthognathic surgery than Female.
Pink colour represents the male and grey colour represents the female.

Graph 3: Bar graph shows a frequency distribution of tooth number sites in which orthognathic surgery had been done. X axis shows the location and the Y axis shows the percentage of orthognathic surgery. Pink colour represents upper arch, brown colour represents lower arch and beige colour represents both arch.

Graph 4: Bar graph shows a frequency distribution of reason in which orthognathic surgery had been done. X axis shows the reason and the Y axis shows the percentage of orthognathic surgery. Blue colour represents the aesthetic reason and green colour represents the functional reason.

Graph 5: Bar graph shows an association of reason of orthognathic surgery and age group. X axis shows the age and Y axis shows the percentage of orthognathic surgery. Blue colour represents functional reason and green colour represents esthetic reason.

Graph 6: Bar graph shows an association of reason of orthognathic surgery and gender. X axis shows the age and Y axis shows the percentage of orthognathic surgery. Blue colour represents aesthetic reason and green colour represents functional reason. Male is the most common gender group to undergo orthognathic surgery for aesthetic reasons.

Graph 7: Bar graph shows orthognathic surgery for functional reasons. X axis shows the functional reasons and Y axis shows the percentage of orthognathic surgery. Purple colour represents TMJ disorders and yellow colour represents prosthetic rehabilitation.

Discussion:
Loss of teeth affect the function of the stomatognathic system, particularly if left untreated over an extended period of time. Orthognathic surgery is most commonly done for young groups who are medically more healthy and shown to be associated with less complication and good prognosis. However when orthognathic surgery is needed in elderly patients who are medically compromised, the fear of complications sets limitations in considering the procedure even if indicated. In this study, 9% of the population were over 35 years and had underwent orthognathic surgery with no major complication, hence proving that the OGS is safe and can be done in all age groups of people.
Orthognathic surgery involves the surgical correction of the components of the facial skeleton to restore the proper anatomical and functional relationship in patients with dentofacial skeletal abnormalities.[33][34] An important component of orthognathic surgery is the bilateral sagittal split osteotomy (BSSO), which is the most commonly

performed jaw surgery, either with or without upper jaw surgery. Several studies have reported the impacts of orthognathic surgery on the psychological, physical, functional, and esthetic aspects of quality of life among patients both before and after surgery[35]. According to the World Health Organization, quality of life is defined as an individual's perception of his/her position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards, and concerns. In addition to the impact on quality of life and patient satisfaction in the postoperative period is another important outcome that can be evaluated, as it is one of the main goals of treatment. Kiyak et al.[12] observes patients' expectations before surgery, and the information provided by the staff may be considered predictors of patient satisfaction after surgery. While the rate of satisfaction following orthognathic surgery is very high, some patients report dissatisfaction with the results despite a successful procedure. [36]The reasons for such dissatisfaction and its impact on patient quality of life have not yet been fully elucidated[37]. Edentulism not only affects the adjacent teeth.[38][39] They may move for an undesirable period of time.[40] It has been demonstrated that dimensional ridge resorption eventually occurs following tooth loss.[41] Various studies on this topic reveals that orthognathic surgery is most commonly for esthetic reason than functional reason.[11] These results coincide with our study orthognathic surgical procedures have been initially disciplined to reposition the jaws and have been traditionally used in the dentate patient to correct a skeletal malocclusion.[42] These procedures are usually carried out with orthodontic control; moreover, these procedures are used on the edentulous patient to correct the description between the maxillary and the mandible associated with the placement of implant to rehabilitate the oral cavity.[43,44] This reconstructive method has the advantages over other commonly used pre prosthetic techniques to have orthognathic surgery, when compared to male.[45][46] Complications such as excessive blood loss, ischemic changes, nasal bleeding, maxillary sinusitis, osteomyelitis[47], condylar sag may occur. This was stated by c.howley.[48] However, mostly these complications are avoided with careful systemic treatment planning and careful evaluation of the surgical procedure,[49] while giving due respect to the underlying philosophy of orthognathic surgery.[50,51]

Conclusion:
Within the limitations of study, it is concluded that orthognathic surgery is commonly used for aiding in management of malocclusion, skeletal deformities, prosthetic rehabilitation, airway management and TMJ deformities in our population. This also confers that OGS is not a procedure limited to the young population alone and can be used for older age groups when needed with positive outcome.

ACKNOWLEDGEMENT:
The authors would like to acknowledge the help and support rendered by the Department of oral and maxillofacial surgery, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University for the constant assistance with the research.

FUNDING:
The present study is funded by
- Saveetha Institute of Medical and Technical science
- Saveetha Dental College and hospitals
- Saveetha University
- Mithra Foundation, Cuddalore.

CONFLICT OF INTEREST:
None declared.

REFERENCES:
1. Naini FB, Gill DS. Orthognathic Surgery: Principles, Planning and Practice. John Wiley & Sons; 2017. 936 p.
2. J PC, Pradeep CJ, Marimuthu T, Krithika C, Devadoss P, Kumar SM. Prevalence and measurement of anterior loop of the mandibular canal using CBCT: A cross sectional study [Internet]. Vol. 20, Clinical Implant Dentistry and Related Research. 2018. p. 531–4. Available from: http://dx.doi.org/10.1111/cid.12609
3. Class III Facial Asymmetry, Mandibular Deviation and Its Related Surgical Orthodontic Treatment [Internet]. Orthodontic Treatment of Class III Malocclusion. 2014. p. 228–58. Available from: http://dx.doi.org/10.2174/978160805491611401001 2
4. Kaul S, Reddy R. Prosthetic rehabilitation of an adolescent with hypohidrotic ectodermal dysplasia with partial anodontia: Case report [Internet]. Vol. 26, Journal of Indian Society of Pedodontics and Preventive Dentistry. 2008. p. 177. Available from: http://dx.doi.org/10.4103/0970-4388.44041
5. Bill J, Proff P, Bayerlein T, Blens T, Gedrange T, Reuther J. Orthognathic surgery in cleft patients. J Craniomaxillofac Surg. 2006 Sep;34 Suppl 2:77–81.
6. Sivakumar A, Nalabothu P, Thanh HN, Antonarakis GS. A Comparison of Craniofacial Characteristics between Two Different Adult Populations with Class II Malocclusion-A Cross-Sectional Retrospective Study. Biology [Internet]. 2021 May 14;10(5). Available from: http://dx.doi.org/10.3390/biology10050438

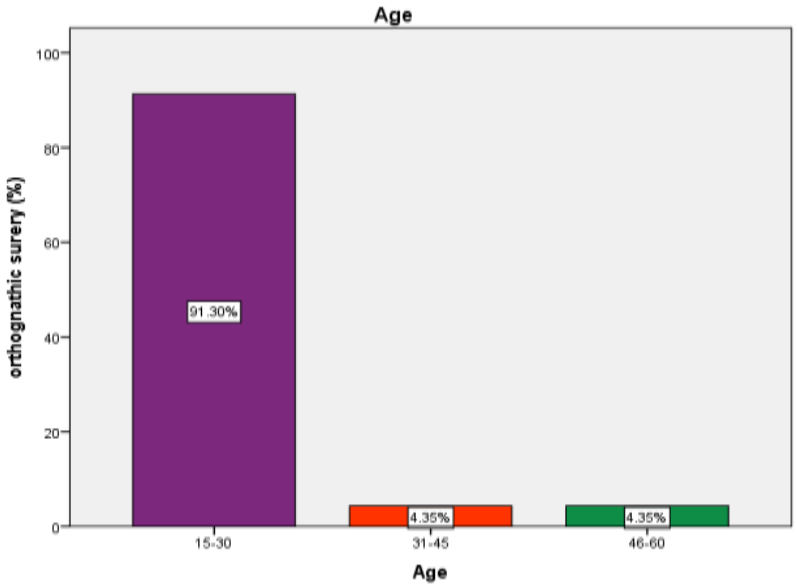
7. Borzabadi-Farahani A, Eslamipour F, Shahmoradi M. Functional needs of subjects with dentofacial deformities: A study using the index of orthognathic functional treatment need (IOFTN) [Internet]. Vol. 69, Journal of Plastic, Reconstructive & Aesthetic Surgery. 2016. p. 796–801. Available from: http://dx.doi.org/10.1016/j.bjps.2016.03.008
8. Gudipaneni RK, Alam MK, Patil SR, Karobari MI. Measurement of the Maximum Occlusal Bite Force and its Relation to the Caries Spectrum of First Permanent Molars in Early Permanent Dentition. J Clin Pediatr Dent. 2020 Dec 1;44(6):423–8.
9. Seward GR. Surgical correction of dentofacial deformities. Volume III. New concepts [Internet]. Vol. 14, Journal of Dentistry. 1986. p. 45–6. Available from: http://dx.doi.org/10.1016/0300-5712(86)90108-9
10. Uma Maheswari TN, Nivedhitha MS, Ramani P. Expression profile of salivary micro RNA-21 and 31 in oral potentially malignant disorders. Braz Oral Res. 2020 Feb 10;34:e002.
11. Avinash CKA, Tejasvi MLA, Maragathavalli G, Putcha U, Ramakrishna M, Vijayaraghavan R. Impact of ERCC1 gene polymorphisms on response to cisplatin based therapy in oral squamous cell carcinoma (OSCC) patients [Internet]. Vol. 63, Indian Journal of Pathology and Microbiology. 2020. p. 538. Available from: http://dx.doi.org/10.4103/ijpm.ijpm_964_19
12. Kiyak HA, Asuman Kiyak H, William McNeill R, West RA, Hohl T, Bucher F, et al. Predicting psychologic responses to orthognathic surgery [Internet]. Vol. 40, Journal of Oral and Maxillofacial Surgery. 1982. p. 150–5. Available from: http://dx.doi.org/10.1016/0278-2391(82)90046-5
13. Chaitanya NC, Muthukrishnan A, Rao KP, Priyanka DR, Ujwala P, Abhijeeth H, et al. Oral Mucositis Severity Assessment by Supplementation of High Dose Ascorbic Acid During Chemo and/or Radiotherapy of Oro-Pharyngeal Cancers – A Pilot Project [Internet]. Vol. 52, Indian Journal of Pharmaceutical Education and Research. 2018. p. 532–9. Available from: http://dx.doi.org/10.5530/ijper.52.3.61
14. Wahab PUA, Abdul Wahab PU, Madhulaxmi M, Senthilnathan P, Muthusekhar MR, Vohra Y, et al. Scalpel Versus Diathermy in Wound Healing After Mucosal Incisions: A Split-Mouth Study [Internet]. Vol. 76, Journal of Oral and Maxillofacial Surgery. 2018. p. 1160–4. Available from: http://dx.doi.org/10.1016/j.joms.2017.12.020
15. Mudigonda SK, Murugan S, Velavan K, Thulasiraman S, Krishna Kumar Raja VB. Non-suturing microvascular anastomosis in maxillofacial reconstruction- a comparative study. Journal of Cranio-Maxillofacial Surgery. 2020 Jun 1;48(6):599–606.
16. Narayanasamy RK, Muthusekar RM, Nagalingam SP, Thyagarajan S, Ramakrishnan B, Perumal K. Lower pretreatment hemoglobin status and treatment breaks in locally advanced head and neck squamous cell carcinoma during concurrent chemoradiation. Indian J Cancer. 2021 Jan;58(1):62–8.
17. Wang H, Chinnathambi A, Alahmadi TA, Alharbi SA, Veeraraghavan VP, Krishna Mohan S, et al. Phyllanthin inhibits MOLT-4 leukemic cancer cell growth and induces apoptosis through the inhibition of AKT and JNK signaling pathway. J Biochem Mol Toxicol. 2021 Jun;35(6):1–10.
18. Li S, Zhang Y, Veeraraghavan VP, Mohan SK, Ma Y. Restorative Effect of Fucoxanthin in an Ovalbumin-Induced Allergic Rhinitis Animal Model through NF-κB p65 and STAT3 Signaling. J Environ Pathol Toxicol Oncol. 2019;38(4):365–75.
19. Ma Y, Karunakaran T, Veeraraghavan VP, Mohan SK, Li S. Sesame Inhibits Cell Proliferation and Induces Apoptosis through Inhibition of STAT-3 Translocation in Thyroid Cancer Cell Lines (FTC-133). Biotechnol Bioprocess Eng. 2019 Aug 1;24(4):646–52.
20. Bishir M, Bhat A, Essa MM, Ekpo O, Ihunwo AO, Veeraraghavan VP, et al. Sleep Deprivation and Neurological Disorders. Biomed Res Int. 2020 Nov 23;2020:5764017.
21. Fan Y, Maghimaa M, Chinnathambi A, Alharbi SA, Veeraraghavan VP, Mohan SK, et al. Tomentosin Reduces Behavior Deficits and Neuroinflammatory Response in MPTP-Induced Parkinson's Disease in Mice. J Environ Pathol Toxicol Oncol. 2021;40(1):75–84.
22. Zhang C, Chen Y, Zhang M, Xu C, Gong G, Veeraraghavan VP, et al. Vicenin-2 Treatment Attenuated the Diethylnitrosamine-Induced Liver Carcinoma and Oxidative Stress through Increased Apoptotic Protein Expression in Experimental Rats. J Environ Pathol Toxicol Oncol. 2020;39(2):113–23.
23. Gan H, Zhang Y, Zhou Q, Zheng L, Xie X, Veeraraghavan VP, et al. Zingerone induced caspase-dependent apoptosis in MCF-7 cells and prevents 7,12-dimethylbenz(a)anthracene-induced mammary carcinogenesis in experimental rats. J Biochem Mol Toxicol. 2019 Oct;33(10):e22387.
24. Saravanakumar K, Park S, Mariadoss AVA, Sathiyaseelan A, Veeraraghavan VP, Kim S, et al. Chemical composition, antioxidant, and anti-diabetic activities of ethyl acetate fraction of Stachys riederi var. japonica (Miq.) in streptozotocin-induced type 2 diabetic mice. Food Chem Toxicol. 2021 Jun 26;155:112374.
25. Veeraraghavan VP, Hussain S, Papayya Balakrishna J, Dhawale L, Kullappan M, Mallavarapu Ambrose J, et al. A Comprehensive and Critical Review on Ethnopharmacological Importance of Desert Truffles: Terfezia claveryi, Terfezia boudieri, and Tirmania nivea. Food Rev Int. 2021 Feb 24;1–20.
26. Wei W, Li R, Liu Q, Devanathadesikan Seshadri V, Veeraraghavan VP, Surapaneni KM, et al. Amelioration of oxidative stress, inflammation and tumor promotion by Tin oxide-Sodium alginate-Polyethylene glycol-Allyl isothiocyanate nanocomposites on the 1,2-Dimethylhydrazine induced colon carcinogenesis in rats. Arabian

Journal of Chemistry. 2021 Aug 1;14(8):103238.
27. Sathya S, Ragul V, Veeraraghavan VP, Singh L, Niyas Ahamed MI. An in vitro study on hexavalent chromium [Cr(VI)] remediation using iron oxide nanoparticles based beads. Environmental Nanotechnology, Monitoring & Management. 2020 Dec 1;14:100333.
28. Chandrasekar R, Chandrasekhar S, Sundari KKS, Ravi P. Development and validation of a formula for objective assessment of cervical vertebral bone age. Prog Orthod. 2020 Oct 12;21(1):38.
29. Ramakrishnan M, Dhanalakshmi R, Subramanian EMG. Survival rate of different fixed posterior space maintainers used in Paediatric Dentistry – A systematic review [Internet]. Vol. 31, The Saudi Dental Journal. 2019. p. 165–72. Available from: http://dx.doi.org/10.1016/j.sdentj.2019.02.037
30. Felicita AS, Sumathi Felicita A. Orthodontic extrusion of Ellis Class VIII fracture of maxillary lateral incisor – The sling shot method [Internet]. Vol. 30, The Saudi Dental Journal. 2018. p. 265–9. Available from: http://dx.doi.org/10.1016/j.sdentj.2018.05.001
31. Su P, Veeraraghavan VP, Krishna Mohan S, Lu W. A ginger derivative, zingerone-a phenolic compound-induces ROS-mediated apoptosis in colon cancer cells (HCT-116). J Biochem Mol Toxicol. 2019 Dec;33(12):e22403.
32. Wan J, Feng Y, Du L, Veeraraghavan VP, Mohan SK, Guo S. Antiatherosclerotic Activity of Eriocitrin in High-Fat-Diet-Induced Atherosclerosis Model Rats. J Environ Pathol Toxicol Oncol. 2020;39(1):61–75.
33. Chaturvedula BB, Muthukrishnan A, Bhuvaraghan A, Sandler J, Thiruvenkatachari B. Dens invaginatus: a review and orthodontic implications [Internet]. Vol. 230, British Dental Journal. 2021. p. 345–50. Available from: http://dx.doi.org/10.1038/s41415-021-2721-9
34. Patil SR, Maragathavalli G, Ramesh DNS, Agrawal R, Khandelwal S, Hattori T, et al. Assessment of Maximum Bite Force in Pre-Treatment and Post Treatment Patients of Oral Submucous Fibrosis: A Prospective Clinical Study [Internet]. Vol. 30, Journal of Hard Tissue Biology. 2021. p. 211–6. Available from: http://dx.doi.org/10.2485/jhtb.30.211
35. Ryan FS, Barnard M, Cunningham SJ. Impact of dentofacial deformity and motivation for treatment: a qualitative study. Am J Orthod Dentofacial Orthop. 2012 Jun;141(6):734–42.
36. Perumalsamy H, Sankarapandian K, Veerappan K, Natarajan S, Kandaswamy N, Thangavelu L, et al. In silico and in vitro analysis of coumarin derivative induced anticancer effects by undergoing intrinsic pathway mediated apoptosis in human stomach cancer [Internet]. Vol. 46, Phytomedicine. 2018. p. 119–30. Available from: http://dx.doi.org/10.1016/j.phymed.2018.04.021
37. Xu S, Liow MHL, Goh KMJ, Yeo W, Ling ZM, Soh CCR, et al. Perioperative Factors Influencing Postoperative Satisfaction After Lateral Access Surgery for Degenerative Lumbar Spondylolisthesis. Int J Spine Surg. 2019 Oct;13(5):415–22.
38. Mischkowski RA, Zinser MJ, Kübler AC, Krug B, Seifert U, Zöller JE. Application of an augmented reality tool for maxillary positioning in orthognathic surgery - a feasibility study. J Craniomaxillofac Surg. 2006 Dec;34(8):478–83.
39. Kumar TVR, Venkata Rajesh Kumar T, Murthy JSR, Rao MN, Bhargava Y. Evaluation of silver nanoparticles synthetic potential of Couroupita guianensis Aubl., flower buds extract and their synergistic antibacterial activity [Internet]. Vol. 6, 3 Biotech. 2016. Available from: http://dx.doi.org/10.1007/s13205-016-0407-9
40. Pfaff MJ, Steinbacher DM. Plastic Surgery Applications Using Three-Dimensional Planning and Computer-Assisted Design and Manufacturing. Plast Reconstr Surg. 2016 Mar;137(3):603e – 616e.
41. Sharma P, Mehta M, Dhanjal DS, Kaur S, Gupta G, Singh H, et al. Emerging trends in the novel drug delivery approaches for the treatment of lung cancer. Chem Biol Interact. 2019 Aug 25;309:108720.
42. Tsuji M, Noguchi N, Shigematsu M, Yamashita Y, Ihara K, Shikimori M, et al. A new navigation system based on cephalograms and dental casts for oral and maxillofacial surgery [Internet]. Vol. 35, International Journal of Oral and Maxillofacial Surgery. 2006. p. 828–36. Available from: http://dx.doi.org/10.1016/j.ijom.2006.02.024
43. Mehta M, Dhanjal DS, Paudel KR, Singh B, Gupta G, Rajeshkumar S, et al. Cellular signalling pathways mediating the pathogenesis of chronic inflammatory respiratory diseases: an update [Internet]. Vol. 28, Inflammopharmacology. 2020. p. 795–817. Available from: http://dx.doi.org/10.1007/s10787-020-00698-3
44. Dua K, Hansbro PM, Wadhwa R, Haghi M, Pont LG, Williams KA. Targeting Chronic Inflammatory Lung Diseases Using Advanced Drug Delivery Systems. Academic Press; 2020. 616 p.
45. Puricelli E. A new technique for mandibular osteotomy [Internet]. Vol. 3, Head & Face Medicine. 2007. Available from: http://dx.doi.org/10.1186/1746-160x-3-15
46. Rajakumari R, Volova T, Oluwafemi OS, Rajeshkumar S, Thomas S, Kalarikkal N. Nano formulated proanthocyanidins as an effective wound healing component [Internet]. Vol. 106, Materials Science and Engineering: C. 2020. p. 110056. Available from: http://dx.doi.org/10.1016/j.msec.2019.110056
47. PradeepKumar AR, Shemesh H, Nivedhitha MS, Mohamed Jubair Hashir M, Arockiam S, Maheswari TNU, et al. Diagnosis of Vertical Root Fractures by Cone-beam Computed Tomography in Root-filled Teeth with Confirmation by Direct Visualization: A Systematic Review and Meta-Analysis [Internet]. Vol. 47, Journal of Endodontics. 2021. p. 1198–214. Available from: http://dx.doi.org/10.1016/j.joen.2021.04.022
48. R H, Hannah R, Ramani P, Tilakaratne WM, Sukumaran G, Ramasubramanian A, et al. Author response for

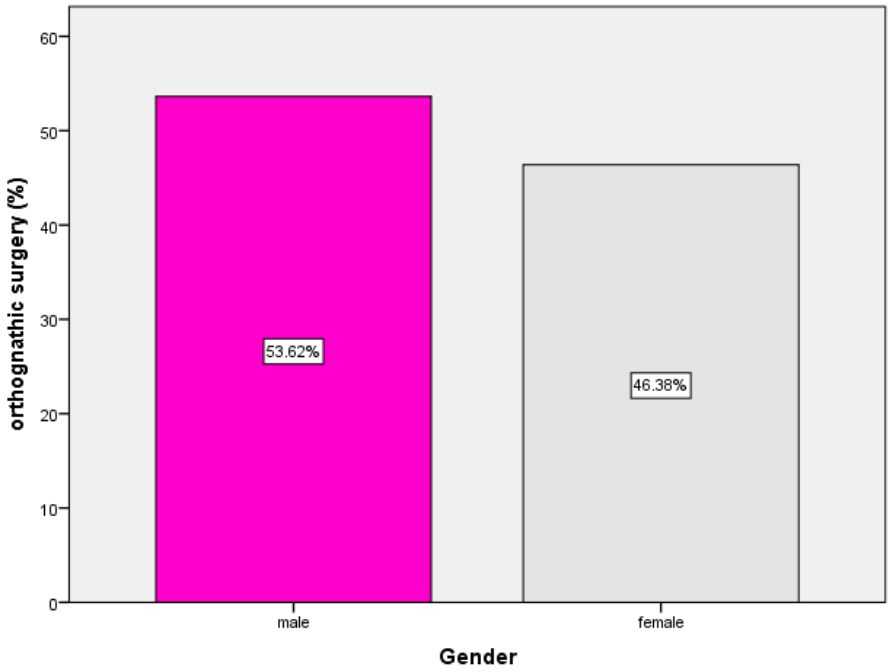
"Critical appraisal of different triggering pathways for the pathobiology of pemphigus vulgaris—A review" [Internet]. 2021. Available from: http://dx.doi.org/10.1111/odi.13937/v2/response1

49. Ezhilarasan D, Devaraj, Ezhilarasan, Manoharan, Subha, Veeraiyan, et al. Author response for "The ambiguous role of sirtuins in head and neck squamous cell carcinoma" [Internet]. 2021. Available from: http://dx.doi.org/10.1111/odi.13798/v4/response1
50. Lacey MS, Colcleugh RG. Infected screws in patients treated by mandibular sagittal split osteotomy [Internet]. Vol. 53, Journal of Oral and Maxillofacial Surgery. 1995. p. 510–2. Available from: http://dx.doi.org/10.1016/0278-2391(95)90059-4
51. Ezhilarasan D, Apoorva VS, Vardhan NA. Syzygium cumini extract induced reactive oxygen species-mediated apoptosis in human oral squamous carcinoma cells [Internet]. Journal of Oral Pathology & Medicine. 2018. Available from: http://dx.doi.org/10.1111/jop.12806
52. Manju, H. C., et al. "Relative economics of major crops under tank rehabilitation interventions of Jala Samvardhane Yojana Sangha (JSYS) in Chitradurga district of Karnataka State." *International Journal of Agricultural Science and Research (IJASR)* 5.2 (2015): 239-250.
53. Chauhan, M. A. N. D. A., R. A. J. N. I. Kalra, and D. H. A. R. M. E. N. D. R. A. Kumar. "Benign paroxysmal positional vertigo in rehabilitation setting: review of diagnosis and intervention." *International Journal of Medicine and Pharmaceutical Science* 6.1 (2016): 67-78.
54. ANANDH, S., R. RAJA, and J. JAYA PRAKASH. "EFFICACY OF SEATED BALANCE EXERCISES WITH SENSORY FEEDBACK ON BALANCED SITTING AMONG HEMORRHAGIC STROKE PATIENTS." *TJPRC: International Journal of Physiotherapy & Occupational Therapy (TJPRC: IJPOT)* 3 (2017): 1-8.
55. Parres, M. D., and B. Sujatha. "Adaptive robotic neuro-rehabilitation haptic device for motor and sensory dysfunction patients." *International Journal of Mechanical and Production* 9 (2019): 131-138.
56. Nezami, Mohsen, and Mozhgan Rahi. "Fragility Analysis of Existing Steel Building and Possible Rehabilitation by Fuzzy Expert Systems Under Blast and Dynamic Loads." *International Journal of Civil, Structural, Environmental and Infrastructure Engineering Research and Development (IJCSEIERD) ISSN (P)* (2016): 2249-6866.
57. Senthilnathan, C. V., A. Gurulakshmi, and K. G. Mohan. "Effects of isometric neck exercises in improving cervical range of motion in long time helmet wearers." *TJPRC: International Journal of Physiotherapy & Occupational Therapy (TJPRC: IJPOT)* 1 (2015): 9-16.

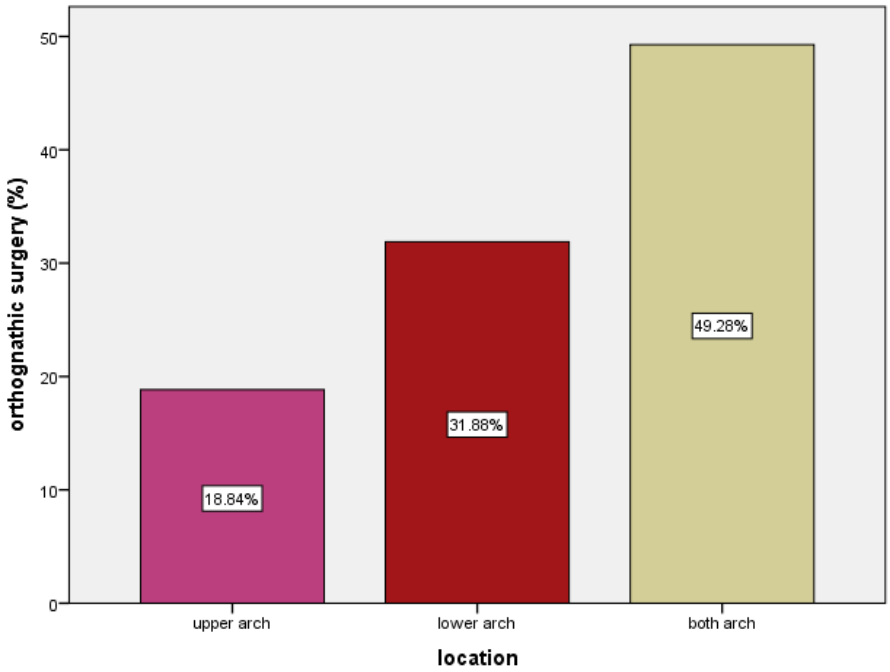
Graph 1:



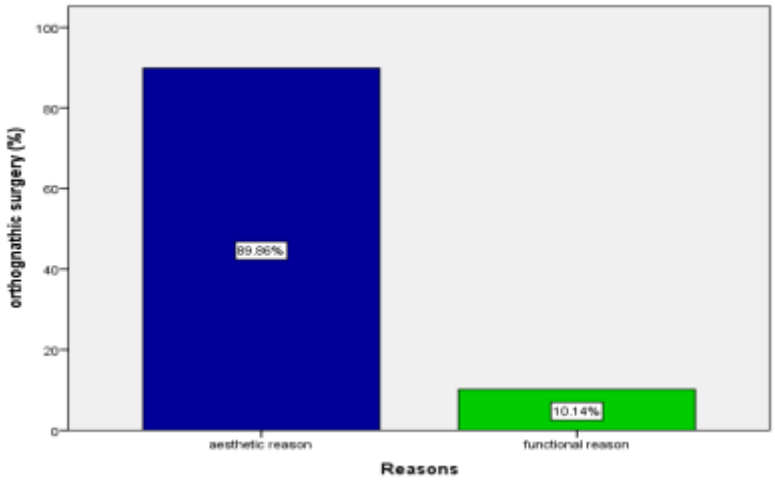
Graph 2:



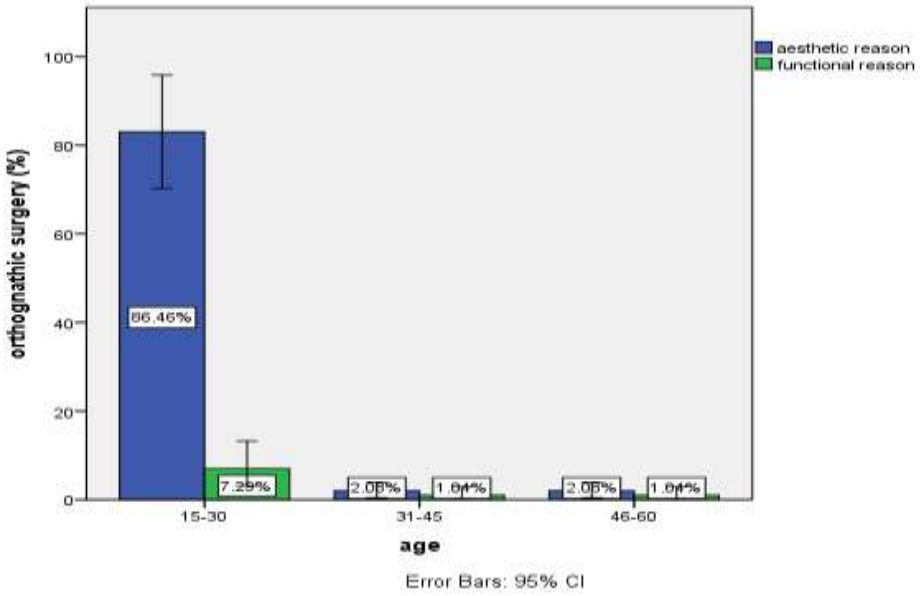
Graph 3:



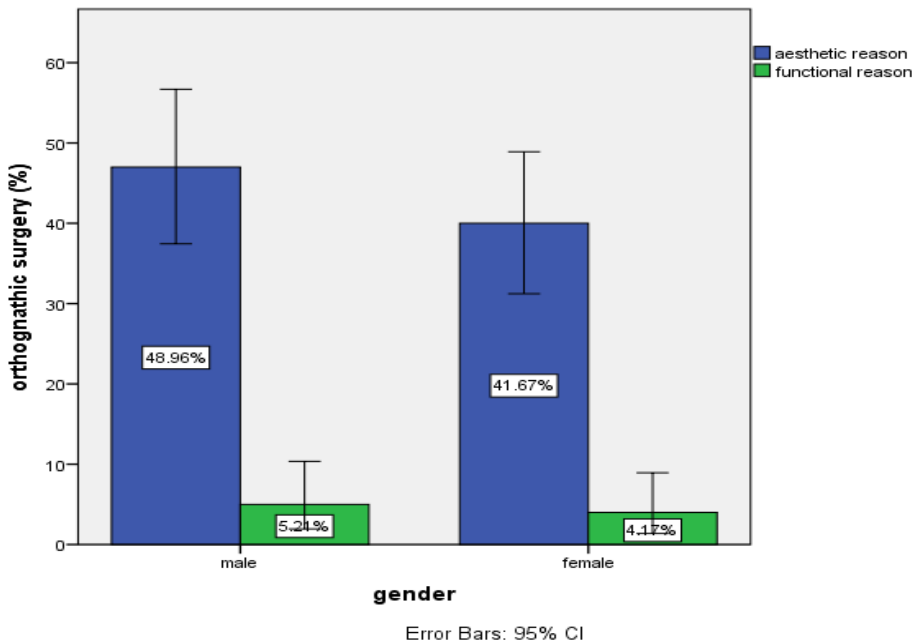
Graph 4:



Graph 5:

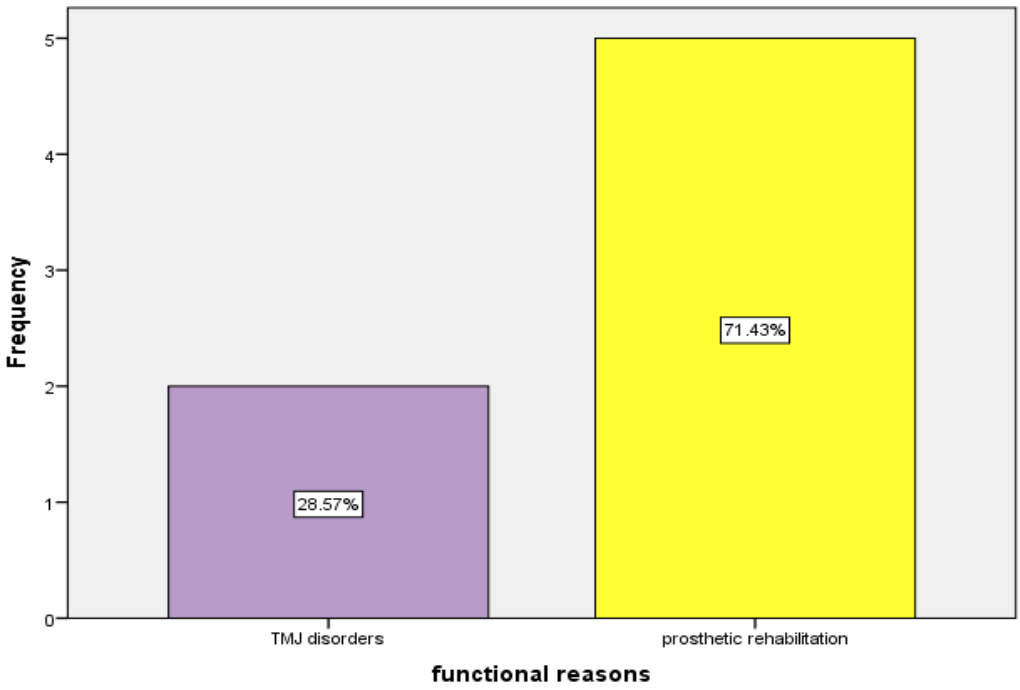


Graph 6:



G

raph 7:


Frequency
5
4
3
2
1
0
28.57%
71.43%
TMJ disorders
prosthetic rehabilitation
functional reasons