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Clinical Paper
TMJ Disorders

Quality of life assessment in temporomandibular joint ankylosis patients after interpositional arthroplasty: a prospective study

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Abstract. Temporomandibular joint (TMJ) ankylosis significantly impacts both physical and psychosocial patient wellbeing. A complete evaluation of treatment outcomes necessitates knowing the extent to which a patient's quality of life (QoL) is impacted. This study was performed to evaluate the impact of TMJ ankylosis on QoL in 25 TMJ ankylosis patients treated by interpositional arthroplasty. The patients completed OHIP-14 and UWQoL questionnaires once before and then at 3 months after the surgery. There was a significant improvement in mean cumulative scores for both questionnaires. With the exception of functional limitation, all OHIP domains showed significant improvement. Preoperatively, the worst scores were found in the psychological distress domain, followed by the social handicap, physical pain and physical disability domains. More than half of the subjects (56%) reported having suicidal thoughts. Amongst the individual UWQoL domains, appearance, chewing, anxiety ($P < 0.01$), recreation and mood ($P < 0.05$) showed improved scores. Appearance and chewing were the top ranked priority domains before and after surgery. No significant change was found in speech, taste, sleep, or breathing. Psychosocial factors were found to play a much bigger role than previously thought. The physical, psychological, and social factors were intricately related and dynamically interacted with each other. Surgical treatment produced a definitive QoL improvement in the patients.

Key words: quality of life; QoL; temporomandibular joint ankylosis; TMJ.

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Temporomandibular joint (TMJ) ankylosis is the pathological fusion of the mandibular condyle to the glenoid fossa by bony or fibrotic tissues and is due to a wide set of aetiologies, with trauma and infection being the most common. The resultant limited mouth opening prevents normal food intake and mastication, restricts diet, and complicates routine oral hygiene, resulting in multiple carious teeth and gingival disease. A number of patients also experience painful mouth opening, sleep disorders, and speech problems. In the growing patient, it distorts normal facial growth resulting in malocclusion and dentofacial deformities. It is quite apparent that these functional and cosmetic problems must pose a definite psychosocial challenge to the patient.

Unfortunately, TMJ ankylosis has largely been described and treated as a physically debilitating condition, with very little, if any, attention paid to its potential psychosocial impact. The treatment outcomes are also evaluated mostly by the physiological (clinical) parameters, and psychosocial factors are largely relegated to the background. This is counterintuitive to the now widely accepted concept that a comprehensive health assessment should include the appreciation of physical, social, and psychological aspects of a condition, in line with the current definition of health as a state of complete physical, mental, and social wellbeing and not merely the absence of disease. Therefore, a complete evaluation of treatment outcomes must also include the impact on quality of life (QoL). If ignored, this might lead to a precarious situation in which the surgeon's satisfaction with the treatment outcome might not translate into a patient's improved perception of his or her QoL.

The gap between the two perceptions (surgeon and patient) needs to be bridged. A QoL study in TMJ ankylosis patients would help understand patient perceptions of their condition, the priority problem areas for them, the aspirations they have from the treatment, and the levels to which they are fulfilled. This broader perspective, encompassing both physiological and psychosocial aspects, would help formulate a suitably optimized evidence-based management plan, monitor treatment effectiveness, and identify areas where greater discourse is required.

The aim of this study was to evaluate the impact of TMJ ankylosis on the QoL of patients and the changes observed after interpositional arthroplasty.

Materials and methods

Study design

The study included TMJ ankylosis patients presenting to the Unit of Oral and Maxillofacial Surgery, Oral Health Sciences Centre, Postgraduate Institute of Medical Education and Research, Chandigarh during the period April 2015 to March 2017. Patients aged 14 years and above with either unilateral or bilateral TMJ ankylosis and who could read or understand English or Hindi were included in the study. The exclusion criteria included patients suffering from severe coexisting systemic conditions or mental/cognitive disorders. Patients requiring multiple interventions due to severe/unusual postoperative complications or reankylosis were also excluded.

Surgical procedure

All surgeries were performed by the same surgeon following standard steps[1]. Under general anaesthesia, an extended pre-auricular incision was used to expose the ankylotic mass, meticulously preserving the surrounding neurovascular structures. The mass was then excised using a variety of burs, chisels, and osteotomes creating an arthroplasty gap of around 1.5–2 cm. A pedicled buccal fat pad (BFP) was used as interpositional material. The dissection was extended anteriorly in a sub-periosteal plane to expose the coronoid process. A periosteal elevator was inserted at its anterior border for retraction. A coronoidectomy, if indicated, was performed at this stage. The main body of the BFP and its temporal extension lie in close proximity to the coronoid process and the temporalis muscle tendon. A simple incision and gentle blunt dissection through the periosteum and the fascial envelope of the BFP, anterior and medial to the coronoid process, exposed the fat, which was gently pulled out of its bed with a vascular clamp. The BFP was then advanced to the arthroplasty gap and secured with one or two sutures just anterior to the external auditory meatus. During layered closure, a suction drain was usually employed. Postoperatively, jaw physiotherapy was generally instituted the day immediately after the surgery using Heister jaw openers. No postoperative complications were noted.

Questionnaires

The enrolled subjects were asked to complete the short form of the Oral Health Impact Profile (OHIP-14) and version 4 of the University of Washington Quality of Life questionnaire (UWQoL v4). The questionnaires were made available in two languages, English and Hindi. The Hindi version was verified by translation and back translation by two bilingual speakers. It was further validated and checked for internal consistency and reliability.

OHIP-14

The short form OHIP-14 is derived from the original 49-item OHIP form introduced by Slade and Spencer in 1994[2,3]. It comprises 14 questions, divided into seven evaluation domains (two questions per domain), i.e. functional limitation, physical pain, psychological distress, physical disability, psychological disability, social disability, and social handicap.

Each question evaluates a frequency, with five possible answers, ranging from 'never' (score zero) to 'very often' (score 4). Higher scores imply a poorer outlook. These scores are multiplied by the weight of each question (weights 0.51, 0.49, 0.34, 0.66, 0.45, 0.55, 0.52, 0.48, 0.60, 0.40, 0.38, 0.62, 0.59, and 0.41 for questions 1–14, respectively). Following extensive deliberations with clinicians engaged in treating TMJ ankylosis patients, three additional questions were added to further enhance the scope of the questionnaire. They were marked questions 15 (unable to sleep properly), 16 (difficulty breathing), and 17 (had suicidal thoughts).

UWQoL v4

Version 4 of the UWQoL is derived from the original form first introduced in 1993 by Hassan and Weymuller[4]. It has a total of 12 domains. For the purpose of this study, two original domains – shoulder and saliva – were replaced by two new domains, i.e. sleep and breathing.

Scoring of the domains ranges from 0 to 100. The worst possible response is represented by '0' and the best possible by '100', with intermediate scores of 25, 50, and 75 indicating the levels between the two. The form also has global questions enquiring about health-related QoL just before and 3 months after the surgery and overall QoL 3 months after the surgery. Patients were also asked to choose the three domains they considered the most important to them and rank them from the most to the least important.

Data analysis

The statistical analysis was done using IBM SPSS Statistics version 22.0 (IBM

Corp., Armonk, NY, USA). Qualitative or categorical variables were described as frequencies and proportions. The paired *t*-test was conducted for normally distributed data and the Wilcoxon test for matched pairs for non-normally distributed data. Relationships between different variables were calculated using Spearman's correlation coefficient. Test–retest reliability and internal consistency were analyzed by generating the intra-class coefficient (ICC) and Cronbach's alpha. All statistical tests were two-tailed, and a *P*-value of <0.05 was taken as significant and of <0.01 as highly significant.

Results

A total of 25 subjects (14 male, 11 female) with a mean age of 21.7 ± 8.13 years were evaluated once preoperatively (T0) and then at 3 months after the TMJ surgery (T1). No significant age- or sex-related differences were found in the QoL scores. Thus, neither sex nor age had any significant effect on the way the QoL items were scored in the questionnaires by the participants. The average duration of ankylosis spanned 10.08 years. The mean preoperative maximum incisal opening (MIO) was 6.16 mm and mean postoperative MIO was 33.76 mm. Statistically, QoL outcomes were not significantly correlated to either the duration of ankylosis or the change in mouth opening. Before the surgery, 12 out of the total 25 participants were recalled and asked to complete both the questionnaires a second time, 2 weeks after their first QoL assessment. The two scores were compared and test–retest reliability was determined by generating the ICC.

Evaluation of the OHIP-14 questionnaire

The OHIP-14 showed a fair level of test–retest reliability (ICC = 0.752) and internal consistency (Cronbach's alpha = 0.867). There was a highly significant drop in the mean cumulative OHIP-14 score after the surgery (T0 = 13.31, T1 = 2.96; $P < 0.01$), indicating overall improved QoL (Fig. 1).

Amongst OHIP domains, with the exception of the functional limitation domain ($P = 0.8$), all other domains showed highly significant improvements in the cumulative domain scores ($P < 0.01$) (Fig. 2).

Preoperatively, the worst scores were found in the psychological distress domain (feeling self-conscious and tense), followed by the physical pain (painful aching in the joints and discomfort eating certain foods) and physical disability (unsatisfactory diet and interruption of meals) domains. Except for the functional limitation domain, the changes in the other domains were significantly correlated with the change in mean cumulative OHIP score. Amongst the individual domains, functional limitation was significantly correlated with social handicap; physical pain with physical disability; psychological distress with physical disability and social handicap; physical disability with physical pain and psychological distress; and social handicap with functional limitation and psychological distress.

With the exception of questions 1 (trouble speaking), 2 (taste), and 12 (difficulty doing usual jobs), all other items showed a significant drop in score, signifying an improvement across all of these items (Fig. 3). Amongst the new added items, although improved scores were seen for all three items (Fig. 4), only question 17 (having suicidal thoughts) showed a significant improvement ($P < 0.05$).

Evaluation of the UWQoL v4 questionnaire

The UWQoL questionnaire showed a fair level of test–retest reliability (ICC = 0.701) and internal consistency (Cronbach's alpha = 0.833). The cumulative UWQoL score showed a significant increase (T0 = 867.5, T1 = 1048.7; $P < 0.01$), suggesting improved QoL after the surgery (Fig. 5). Amongst the individual UWQoL domains, a highly significant improvement was seen in appearance, chewing, and anxiety ($P < 0.01$), while recreation and mood showed a significant improvement ($P < 0.05$) (Fig. 6). There was also a highly significant increase in the global score for health-related QoL ($P < 0.01$). The mean cumulative postoperative QoL score was 93.75 (out of 100).

There was a significant positive correlation of recreation with mood, anxiety, and sleep domains; mood with anxiety and sleep; and sleep with recreation, speech, mood, and breathing. The criterion validity was reaffirmed by the significant correlation of global QoL scores with cumulative UWQoL scores. Preoperatively, almost half of the subjects ($n = 12$) ranked appearance as their topmost concern, followed by chewing,

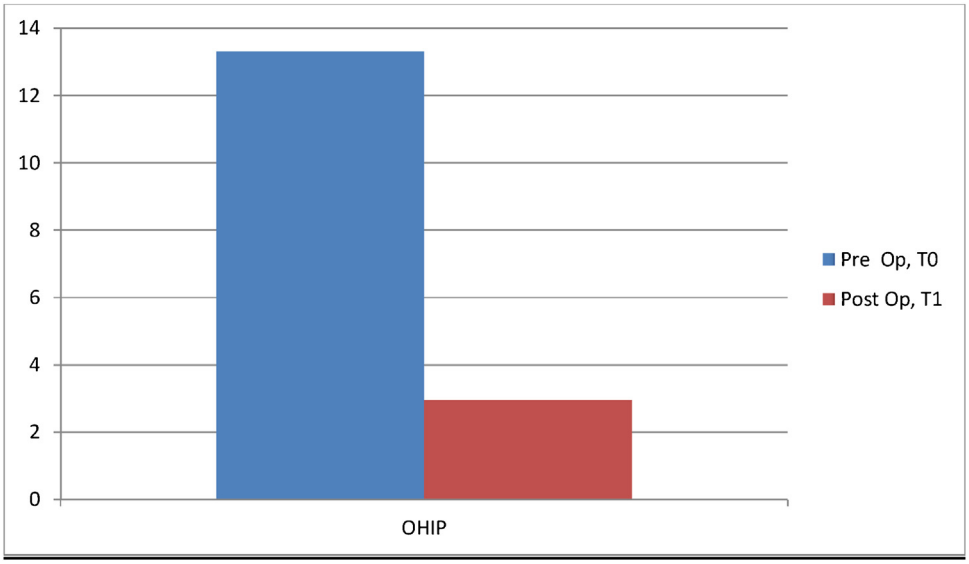


Fig. 1. Changes in mean cumulative OHIP scores.

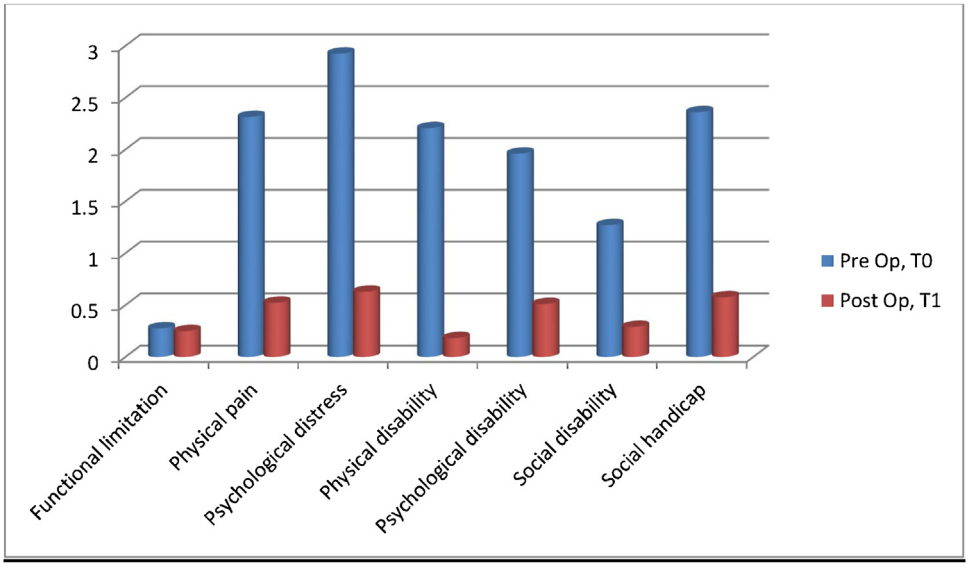


Fig. 2. Changes in mean scores across all OHIP domains.

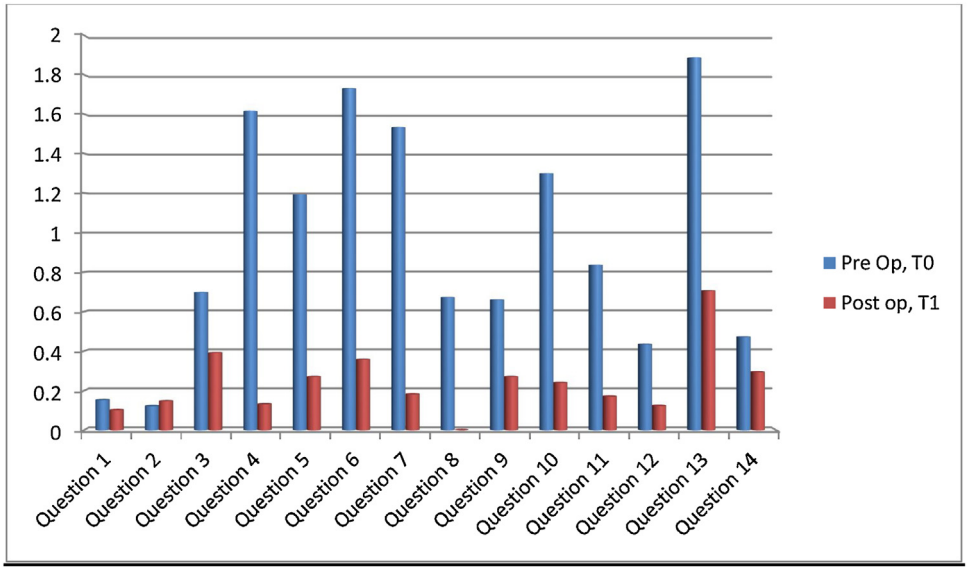


Fig. 3. Changes in mean scores across individual OHIP items: Q1, have you had trouble speaking; Q2, have you felt that your sense of taste has worsened; Q3, have you had painful aching in the mouth or joint; Q4, have you found it uncomfortable to eat any foods; Q5, have you been self-conscious; Q6, have you felt tense; Q7, has your diet been unsatisfactory; Q8, have you had to interrupt meals; Q9, have you found it difficult to relax; Q10, have you been embarrassed; Q11, have you been a bit irritable with other people; Q12, have you had difficulty doing your usual jobs; Q13, have you felt that life in general is less satisfying; Q14, have you been totally unable to function?.

which was given top priority by seven patients. Postoperatively, eight patients still had appearance as their topmost concern, followed by chewing, which was given top priority by five patients (Fig. 7). Five patients did not have any priority areas after the surgery and chose not to mark any domain.

There was a highly significant correlation between the cumulative scores of the two questionnaire forms at T0 (correlation coefficient −0.708) and T1 (correlation coefficient −0.509). The negative sign is due to the fundamentally opposite scoring methods employed by the two questionnaires; i.e. a higher score in the OHIP-14 implies worsening, while a higher score in UWQoL implies improvement. This finding along with the clinically observed improved mouth function and significant correlation with improved global scores proved the construct validity of both questionnaires for QoL evaluation in this group.

Discussion

TMJ ankylosis was found to have a definite impact on both the physical and the psychosocial aspects of patient lives. The surgical procedure improved patient QoL across all ages and both sexes. There was a significant improvement in almost all of

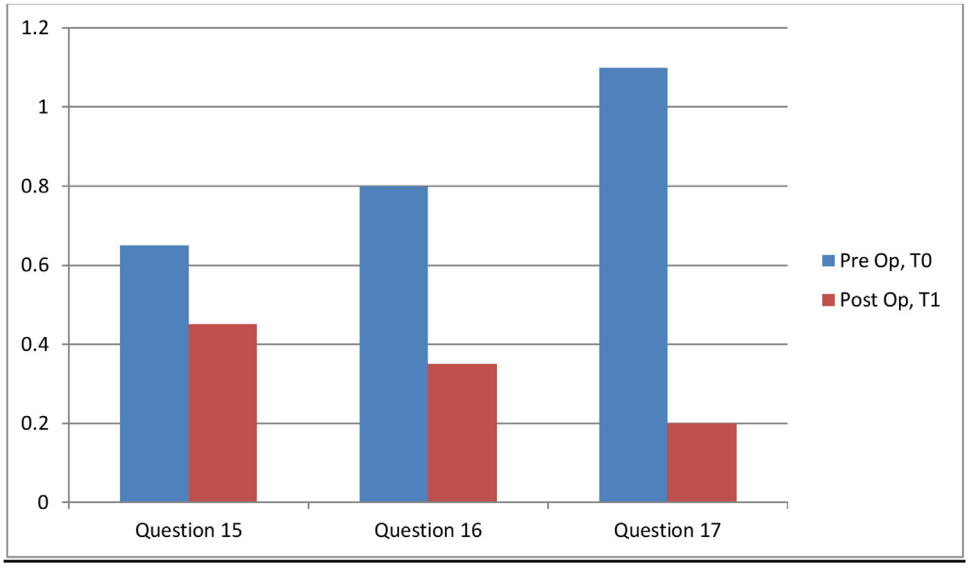


Fig. 4. Changes in mean scores of the newly added OHIP items: Q15, have you been unable to sleep properly; Q16, have you had difficulty breathing; Q17, have you had suicidal thoughts?.

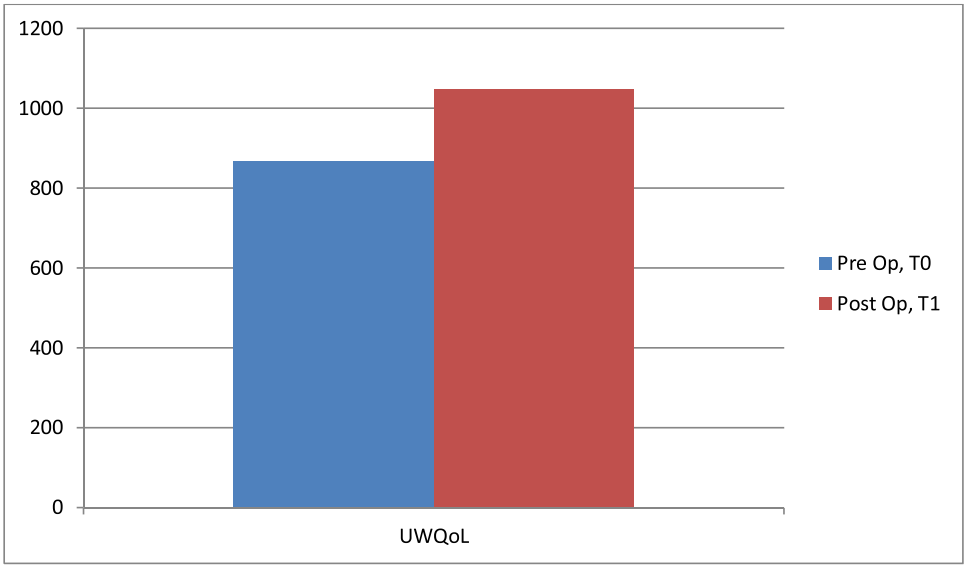


Fig. 5. Change in mean cumulative UWQoL score.

the physical factors, translating to better mouth opening, improved mastication, less pain during function, and a better diet. Interestingly, the change in QoL was not significantly related to the change in mouth opening, highlighting the need to look beyond the usual physiological parameters when evaluating treatment outcomes. Speech was unaffected, probably because the speech mechanism is largely disassociated from the temporomandibular region and speech development is usually complete in the early years before the ankylosis-producing event. Even though TMJ ankylosis has been documented to produce sleep and breathing disorders, most notably obstructive sleep apnoea, no such complaints were found in the study patients, probably because the growth deficit was not significant enough to have any effect. Although the facial asymmetry secondary to TMJ ankylosis persisted, most subjects reported an improvement in their physical appearance. The better body image perception could be due to improved mouth opening and the resultant improved self-confidence. Appearance, although defined as a physical factor in the original UWQoL form, could therefore more suitably be studied as a psychosocial factor in this class of patients.

Closely mirroring the physical factors, the psychosocial factors also showed significant improvement. The subjects were less self-conscious, more relaxed, and had better mood and reduced stress. They were also more comfortable in social settings, less irritable with other people, and more efficient in performing routine activities. The worst scored items in both questionnaires were essentially psychosocial, hinting at the relatively greater influence these factors wield over the cumulative QoL. The significant correlations demonstrated the dynamic interplay between the physical and psychosocial factors. Physical disability gives rise to psychological distress,

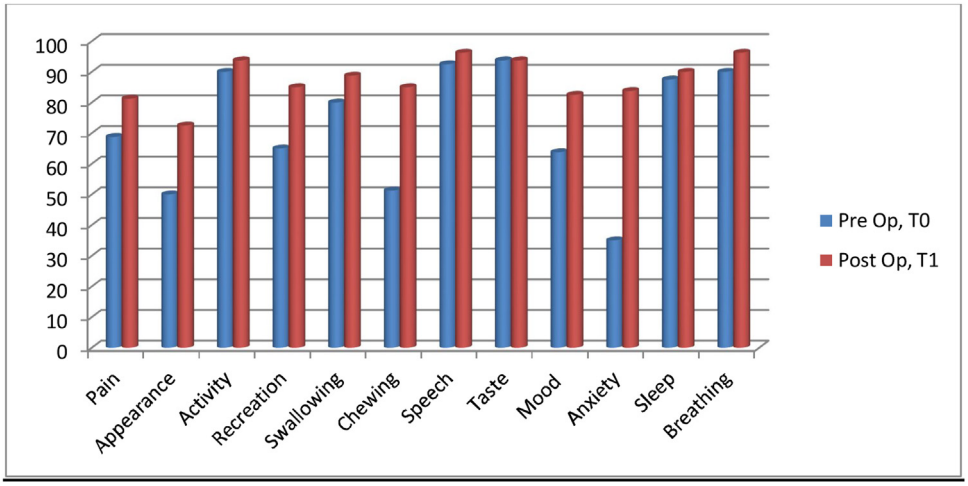
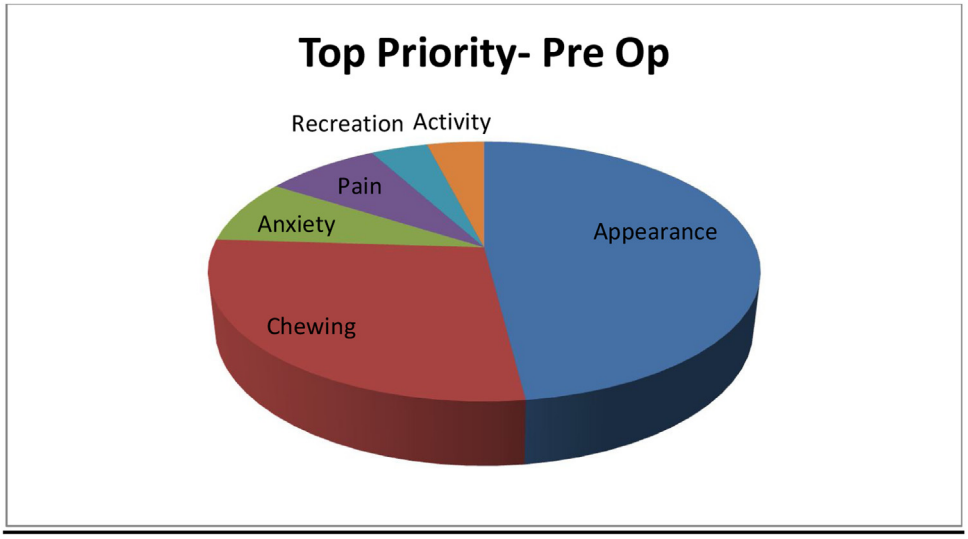


Fig. 6. Changes in mean scores across all UWQoL domains.



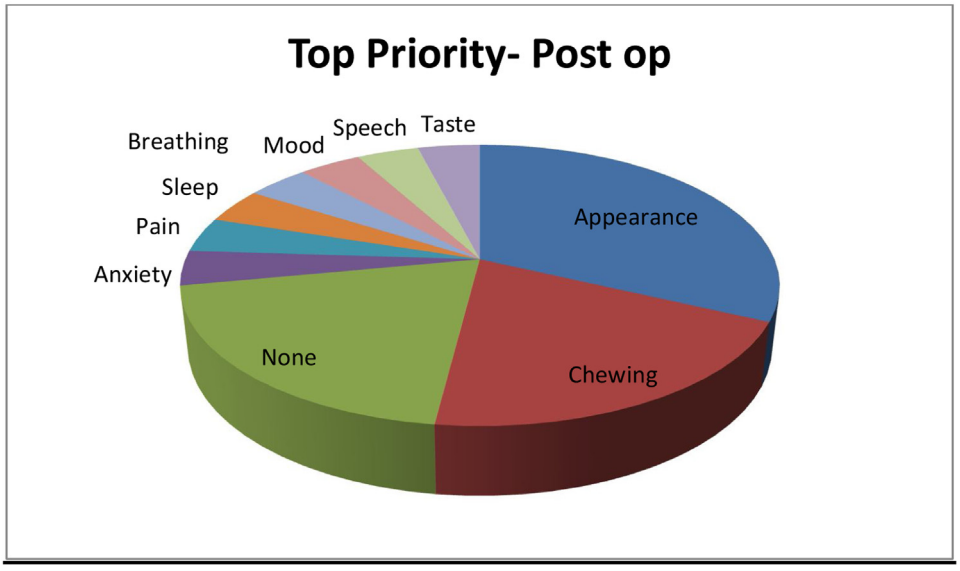


Fig. 7. Top ranked UWQoL priority domains pre- and postoperatively.

which leads to a loss of social function and eventually social isolation, which further compounds the psychological distress. Any effective management strategy would therefore have to disrupt this vicious circle.

One significant example of psychological challenge was demonstrated by the results derived from question 17 (had suicidal thoughts) of the OHIP. This indicated that before the surgery, 56% of the subjects had thought about ending their lives at least once or twice. In fact, two subjects confessed to having had suicidal thoughts every day (score 4), while three had such thoughts quite often (score 3). This was an interesting finding, as TMJ ankylosis has not usually been described in conjunction with suicidal tendencies. It was also found that patients who had poor social disability scores (more embarrassed and irritable in social settings) had a higher propensity towards depression and suicidal tendencies. This emphasizes the important role played by the people around these patients, i.e. family members, friends, or colleagues, in shaping the QoL outcomes; effective management must include their active participation. TMJ surgery provides these patients with new hope and the promise of a better future. It is the present authors' firm belief that this particular item should be considered for inclusion as a standard item in a TMJ ankylosis-specific form.

An argument could be raised that, contrary to the conventional wisdom, the psychosocial factors rather than the physical factors might be the primary drivers for some patients to seek treatment. In simple words, a TMJ ankylosis patient visiting a clinician could be driven primarily by an expected improvement in his or her facial aesthetics rather than the need for better chewing function. This argument is supported by the fact that aesthetics (appearance) rather than jaw function/chewing was the top priority area preoperatively for a significant number of patients. Anxiety (usually related to job or marriage) was also an important priority area. The findings highlight the need to include these factors as guiding points at all stages of the treatment, i.e. preoperative patient counselling, preoperative surgical planning, the choice of surgical procedure, postoperative occlusal and facial rehabilitation, and the probability of future surgical procedures. This would also make the informed consent a truly 'informed' one.

Interestingly, both appearance and chewing, despite showing significant improvement, remained the two top concerns even after the surgery, clearly underlining the need to do more. Importantly, many patients had either no priority domains (20%) or one priority domain (28%) after the surgery, suggesting that a number of concerns were addressed through the surgery and only a few concerns, especially those pertaining to appearance and chewing, remained and could adversely influence QoL in the postoperative phase.

Both questionnaires employed proved to be effective QoL tools for TMJ ankylosis. The OHIP-14 has been used and validated successfully in a wide range of studies analyzing QoL changes in patients suffering from oral dysesthesia, oral premalignant lesions, and oral cancer, as well as in patients undergoing orthognathic surgery for jaw discrepancies and in resective–reconstructive surgery for lesions like ameloblastoma[5–11]. In a systematic review, the OHIP-14 was found to be one of the most popular QoL tools for temporomandibular disorders (TMD)[12].

UWQoL is commonly used to evaluate the QoL outcomes in patients suffering from head and neck cancers and has shown excellent construct validity and internal consistency[7,13–15]. This questionnaire and its revised version were used by Dimitroulis et al. to develop a TMJ surgery-specific QoL questionnaire (TMJ-S-QoL), which they used successfully to measure QoL changes in cross-sectional studies on patients undergoing TMJ procedures like discectomy, condylectomy, rib grafting, and prosthetic joint placement[16,17]. However, the authors have not satisfactorily proven the construct validity of the new form, considering the substantial magnitude of the changes made to the original validated UWQoL. In the present study, a slightly modified form of the UWQoL was used, replacing the saliva and the shoulder domains with sleep and breathing domains, respectively, while all other items were retained. The psychometric properties of the form were then satisfactorily established. Along with the OHIP, the UWQoL questionnaire was used successfully by Zhu et al. to analyze QoL changes in ameloblastoma patients who had undergone mandibular resection and immediate reconstruction with fibula free flaps[7].

Despite being satisfactorily effective, both forms could benefit from further improvements. The OHIP functional limitation domain (speech and taste) did not show any significant change. Most patients did not have any speech or taste problems to start with, as suggested by the low preoperative scores. The taste function showed worsening, which although insignificant was still an intriguing finding. Even though no such observation has ever been made in association with TMJ ankylosis, a study on TMD patients observed that the frequency of taste disturbances was well correlated with the dysfunctional grade of TMD pain in a graded manner[18]. Two of the three new added items, i.e. question 15 (difficulty sleeping) and question 16 (difficulty breathing), also showed very low preoperative scores and an insignificant improvement after the surgery. All of these items could be considered for further review to make the OHIP-14 more specific to TMJ ankylosis. Furthermore, the OHIP questionnaire used in the study utilizes a Likert-type scale, and interpretations of the scores on a linear scale may have limitations, as successive categories may not be equidistant.

In tandem with OHIP findings, the UWQoL domains of taste and swallowing, as well as the newly added domains of sleep and breathing, did not show significant changes. These domains could therefore be considered less important contributors and should be further scrutinized. Undoubtedly, a larger sample size and a longer follow-up period would provide a better outlook with regard to the QoL changes, since the comprehensive treatment of TMJ ankylosis is multidisciplinary and takes shape over a period of time.

In conclusion, with the patient's role increasing from a mere care-receiver to an active decision-maker, it is imperative to have a patient-centric measurement of treatment outcomes. This novel QoL assessment study found a definite impact of TMJ ankylosis on both the physical and psychosocial QoL parameters and a significant improvement after TMJ surgery. Physiological parameters alone were found to be inadequate to fully measure the impact of the disease. Psychosocial factors may play a much larger role in shaping QoL than previously thought. To ensure optimum QoL outcomes, the interrelationship between various factors should be taken into account at each step of management. At the heart of any surgical or medical procedure that is undertaken to treat a disease lies one very basic yet paramount motive, which is to bring happiness to the affected. Undoubtedly, QoL assessments are one significant step in this direction and come closest to actually answering the question most commonly asked by the treating doctor to their patients, ''How are you feeling?''

Funding

None to declare.

Competing interests

None to declare.

Ethical approval

Ethical approval was obtained from the Institutional Ethics Committee (Letter No. nk/2412/mds/12972-37).

Patient consent

Informed consent was obtained from the patients or caregivers (in the case of patients under 18 years of age).

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.ijom.2019.04.017.

References

1. Rattan V. A simple technique for use of buccal pad of fat in temporomandibular joint reconstruction. *J Oral Maxillofac Surg* 2006;**64**:1447–51.
2. Slade GD, Spencer AJ. Development and evaluation of the Oral Health Impact Profile. *Community Dent Health* 1994;**11**:3–11.
3. Slade GD. Derivation and validation of a short-form oral health impact profile. *Community Dent Oral Epidemiol* 1997;**25**:284–90.
4. Hassan SJ, Weymuller EA. Assessment of quality of life in head and neck cancer patients. *Head Neck* 1993;**15**:485–96.
5. Riordain RN, Moloney E, O'Sullivan K, McCreary C. Validity and reliability of patient-centered outcome measures in oral dysesthesia. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2011;**112**:597–601.
6. Karbach J, Al-Nawas B, Moergel M, Daublander M. Oral health-related quality of life of patients with oral lichen planus, oral leukoplakia, or oral squamous cell carcinoma. *J Oral Maxillofac Surg* 2014;**72**:1517–22.
7. Zhu J, Yang Y, Li W. Assessment of quality of life and sociocultural aspects in patients with ameloblastoma after immediate mandibular reconstruction with a fibular free flap. *Br J Oral Maxillofac Surg* 2014;**52**:163–7.
8. Kurabe K, Kojima T, Kato Y, Saito I, Kobayashi T. Impact of orthognathic surgery on oral health-related quality of life in patients with jaw deformities. *Int J Oral Maxillofac Surg* 2016;**45**:1513–9.
9. Silva I, Cardemil C, Kashani H, Bazargani F, Tarnow P, Rasmusson L, Suska F. Quality of life in patients undergoing orthognathic surgery—a two-centered Swedish study. *J Craniomaxillofac Surg* 2016;**44**:973–8.
10. Lee S, McGrath C, Samman N. Impact of orthognathic surgery on quality of life. *J Oral Maxillofac Surg* 2008;**66**:1194–9.
11. Rustemeyer J, Gregersen J. Quality of life in orthognathic surgery patients: post-surgical improvements in aesthetics and self-confidence. *J Craniomaxillofac Surg* 2012;**40**:400–4.
12. Bitiniene D, Zamaliauskiene R, Kubilius R, Leketas M, Gailius T, Smirnovaite K. Quality of life in patients with temporomandibular disorders. A systematic review. *Baltic Dent Maxillofac J* 2018;**20**:3–9.
13. Rogers SN, Lowe D, Fisher SE, Brown JS, Vaughan ED. Health-related quality of life and clinical function after primary surgery for oral cancer. *Br J Oral Maxillofac Surg* 2002;**40**:11–8.
14. Rogers SN, Laher SH, Overend L, Lowe D. Importance-rating using the University of Washington Quality of Life questionnaire in patients treated by primary surgery for oral and oro-pharyngeal cancer. *J Craniomaxillofac Surg* 2002;**30**:125–32.
15. Raghuram P, Ketan C, Flood V, Leo FA. Quality of life outcome measures using UW-QOL questionnaire v4 in early oral cancer/squamous cell cancer resections of the tongue and floor of mouth with reconstruction solely using local methods. *Br J Oral Maxillofac Surg* 2013;**51**:502–7.
16. Dimitroulis G, McCullough M, Morrison W. Quality-of-life survey comparing patients before and after discectomy of the temporomandibular joint. *J Oral Maxillofac Surg* 2010;**68**:101–6.
17. Dimitroulis G. Comparison of the outcomes of three surgical treatments for end-stage temporomandibular joint disease. *Int J Oral Maxillofac Surg* 2014;**43**:980–9.
18. Nixdorf DR, John MT, Schierz O, Bereiter DA, Hellekant G. Self-reported severity of taste disturbances correlates with dysfunctional grade of TMD pain. *J Oral Rehabil* 2009;**36**:792–800.

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