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Impact of Prolonged Orthodontic Treatment on Oral Cavity

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ABSTRACT :
A survey conducted in Maharashtra, India, among 250 orthodontic patients investigated the effects of prolonged orthodontic treatment on oral health and daily life. The research found that most patients maintained twice-daily brushing but faced challenges like difficulty in cleaning fixed appliances, frequent oral ulcers, heightened sensitivity, and noticeable aesthetic changes during extended treatment.
Statistical analysis highlighted significant links between prolonged treatment duration and struggles in oral hygiene maintenance ($p < 0.001$), occurrences of oral ulcers ($p < 0.001$), and uncomfortable aesthetic changes ($p < 0.001$). Participants reported considerable impacts on daily activities such as eating, speaking, and smiling, indicating adjustments and discomfort during extended treatment. Notably, many experienced post-treatment relapse ($p < 0.001$), highlighting the difficulty in maintaining treatment outcomes.
Addressing these challenges through personalized treatment plans and emphasizing consistent oral hygiene practices is crucial to minimize adverse effects and enhance patient satisfaction.

KEYWORDS : Root resorption, Periodontal disease , Pulp vitality , TMD , Sensitivity, Enamel Decalcification , Pain, Facial profile, Relapse

I. INTRODUCTION :

Orthodontic treatment, a facet within dentistry, like other disciplines in this field can have adverse effects linked to the duration of treatment implementation. In recent years, the demand for esthetic and orthodontic treatments has greatly increased among both adolescents and adults [14]. Both patients and orthodontists are significantly concerned about the duration of treatment. Patients seek this information to gauge treatment costs and anticipate any discomfort resulting from orthodontic brackets. It should be noted that prolongation of treatment can compromise a significant aspect of treatment, i.e., cost-effectiveness for patients and can adversely affect their oral cavity.

On the other hand, shorter treatment courses are frequently associated with fewer side effects [15]. Orthodontic treatment is often accompanied by some biological complications, and longer treatments may also increase the risk of root resorption [15]. Thus, adequate awareness of the factors affecting the course and duration of treatment can help orthodontists achieve favorable results in the shortest duration possible . Prolonged orthodontic treatment can have both positive and negative impacts on an individual's oral health and overall well-being.

On the positive side, it allows for the correction of complex dental issues, such as misaligned teeth and malocclusions, ultimately improving the patient's oral function and aesthetics. Orthodontic procedures are designed to correct misaligned teeth and bite irregularities, resulting in a more harmonious and functional occlusion. As a consequence, patients often experience enhanced self-esteem and confidence due to the transformation of their smiles. Furthermore, properly aligned teeth are easier to clean, which reduces the risk of dental decay and gum disease. This, in turn, contributes to better long-term oral health. Orthodontic treatment can also address issues like speech difficulties, excessive wear on teeth, and even jaw pain, thus improving overall oral well-being.

However, there are also potential drawbacks to extended orthodontic treatment ,as it can sometimes lead to dental discomfort and oral hygiene challenges. Moreover it becomes more difficult to clean teeth and brackets properly over time. There is also the risk of root resorption, where the roots of teeth may shorten due to the prolonged pressure exerted by braces or other orthodontic appliances. This condition is known as external apical root resorption (EARR) [14]. If excess forces are used or due to loss of torque with subsequent pressure on roots by the cortical bone,

the roots become shorter . Some patients experience root resorption with a symptom of slight blunting of the tips of the roots [14]. Rendering prolong treatment results in potential risks of both hard and soft tissue damage. This may include enamel demineralization, pulp degeneration, root resorption, gingival enlargement, lacerations, allergic reactions and temporomandibular joint disorders, apart from the fact that the treatment procedure may fail in itself.

Orthodontic forces against teeth can cause pain by compressing the vasculature in the periodontal ligament (PDL) resulting in inflammation of both the pulp and periodontal tissues [16]. Following the installment of the primary archwire in a fixed appliance, most patients typically undergo discomfort that initiates around the 4-hour mark, reaches its peak at 24 hours, and gradually subsides over the subsequent three days [16]. Whilst the archwire sequence may not significantly contribute to the overall pain experience, stiffer wires can result in a higher peak pain level . Heat-activated nickel titanium (NiTi) wires may also cause less pain than regular NiTi wires.

Furthermore, wearing braces for an extended period may contribute to psychological stress, self-esteem issues, and a decreased quality of life, especially in adolescents. Patients' self-confidence might be adversely affected by visibility of the appliance and speech impairment, especially during social interactions when attention is focused on the face, eyes, and mouth. Poor oral health can affect physical, psychological, and social conditions, which in turn affect patients' quality of life. Decalcification of enamel or white spots is a common adverse effect of orthodontic treatment. Decalcification is considered to be the first step toward cavitation [14]. Decalcification of enamel occurs in 50% of orthodontic patients and the most affected teeth are the maxillary incisors (Gorelick et al., 1982) [14]. Moreover, these lesion have the potential to manifest within a four weeks, aligning with the usual orthodontic follow-up appointments.

Fixed orthodontic appliance therapy may cause functional restrictions, discomfort, and pain. Discomfort is expressed as unpleasant tactile sensations, feeling of constraint in the oral cavity, stretching of the soft tissues, pressure on the mucosa, displacement of the tongue, and soreness of teeth and pain. All orthodontic procedures such as separator placement, arch wire placement and activations, application of orthopedic forces, and debonding produce pain in patients. Pain, induced by orthodontic treatment, generally could be categorized as mild- and short-lasting. However, some patients do experience severe pain, even to the extent that mastication of food and tooth brushing might be impaired. Pain is a subjective response and shows large individual variations.

Orthodontic discomfort, often noted as the primary adverse outcome of applying orthodontic force, raises significant concerns among parents, patients, and clinicians alike. Studies have reported this reaction to be a major deterrent to orthodontic treatment and an important reason for discontinuing treatment [17]. The effect of fixed lingual appliances on speech is also well acknowledged. Apart from encroaching on surfaces required for phonation, lingual appliances can interfere with speech by causing ulceration to the tongue . Orthodontic treatments may jeopardize the stability of the periodontal structures by shifting tooth roots beyond their natural housing in the jawbone and reducing the thickness of the gum tissue attached to them. The labial aspect of the lower incisors, is more prone to experiencing gum recession due to these factors.

II. MATERIALS AND METHODOLOGY:

A cross-sectional questionnaire study was conducted in Maharashtra, among the general population. This study was aimed to assess the knowledge, attitude and practice regarding the positive and negative impact of prolonged orthodontic treatment on the society. The study duration was three months. The participants were selected based on the inclusion criteria: Orthodontic Patients.

The parameters for sample size calculation were as follows-alpha error 0.5, power of the study 80%, degree of freedom as 5, size effect medium using G power software versions 3.192. The calculated sample size was 246. Hence, the final consideration count was above 250. The convenient sampling technique was used in study. The questionnaire was prepared in English language. The questionnaire was pretested and validated among 32 subjects to assess their knowledge, clarity and responsiveness. The reliability statistics were calculated and the Cronbach Alpha was 0.835.

After reviewing abstracts, the full text of all relevant articles was accessed. Only English-language articles from peer-reviewed journals were . The Performa was designed to collect data and consisted of different sections with 33 questions regarding knowledge, attitude and practices. Section one included the demographic data of subjects such as name, age, designation, gender, etc. The second section included questions related

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to experience of participants, knowledge and practice. The questionnaire was designed on Google form (Google LLC, Mountain View, California United States) and the link was distributed among study population via email, WhatsApp and other social media platform. The statistical analysis was done using the descriptive statistics.

III. RESULTS:

Table 1: Demographic distribution of study participants:

Parameters		Frequency	Percent	p value
Age group	**>20 years**	51	20.5	<0.001**
	21-30 years	173	69.5	
	31-40 years	20	8.0	
	41-50 years	5	2.0	
Gender	**Male**	124	49.8	0.949 NS
	Female	125	50.2	

Most of the participants were in the age group of 21-30years and least in the age group of 41-50 years. Statistically significant association was found between different age group and oral hygiene status (p<0.001).

Table 2: Response of study participants to the oral hygiene and impact of prolonged orthodontic treatment:

Parameters		Frequency	Percent	p value
Duration of orthodontic treatment	1 year	69	27.7	<0.001**
	2 years	121	48.6	
	3 years	38	15.3	
	4 years	18	7.2	
	1 month	3	1.2	
How frequently do you visit your dentist for check-up during treatment?	Every month	79	31.7	<0.001**
	Every 2-3 months	122	49.0	
	Every 4-6 months	34	13.7	
	Less frequently	14	5.6	

Statistically significant association was found between duration of orthodontic treatment and oral hygiene status (p<0.001). Statistically significant association was found between frequency of dental visit oral hygiene status (p<0.001).

How did you maintain oral hygiene after starting with braces?	Brush once a day	52	20.9	<0.001**
	Brush twice a day	126	50.6	
	Rinse after every meal	45	18.1	
	Use interdental brush or mouthwash	26	10.4	
Any cavity observed in any tooth, during orthodontic treatment?	No	117	47.0	0.342 NS
	Yes	132	53.0	

Most of the study participants reported problems in oral hygiene p<0.001 except for any cavity observed in any tooth, during orthodontic treatment.

Statistically significant association was found between frequency of brushing after starting orthodontic treatment and oral hygiene status (p<0.001).

Table 3: Response of study participants to the experience and impact of prolonged orthodontic treatment:

Parameters		Frequency	Percent	p value
Was there any food	No	77	30.9	<0.001**

lodgement, difficulty in clean, in your fixed appliance?	Yes	172	69.1	

Statistically significant association was found between difficulty in cleaning and prolonged orthodontic treatment (p<0.001).

Did you experience any ulceration in your mouth?	No	23	9.2	<0.001**
	Yes, occasionally	147	59.0	
	Yes, Frequently	79	31.7	
Did you notice any uncomfortable change in your facial profile	Significant changes	19	7.6	<0.001**
	Moderate changes	52	20.9	
	Minimal changes	137	55.0	
	No changes	41	16.5	

Statistically significant association was found between ulceration in mouth and prolonged orthodontic treatment (p<0.001). Also, Statistically significant association was seen between uncomfortable changes in facial profile and prolonged orthodontic treatment (p<0.001).

Were you required to get an extraction before the treatment?	No	101	40.6	0.003*
	Yes	148	59.4	
Did you encounter any difficulty in speaking or eating?	None	15	6.0	<0.001**
	Speaking	25	10.0	
	Eating	92	36.9	
	Both	117	47.0	
Did you experience any sensitivity after application of orthodontic appliance?	No	96	38.6	<0.001**
	Yes	153	61.4	
Did it aid or hinder mastication?	No effect	46	18.5	<0.001**
	Aids mastication	51	20.5	
	Hinder mastication	152	61.0	

Statistically significant association was found between requirement of extraction and prolonged orthodontic treatment (p=0.003)

Statistically significant association was found between difficulty in speaking , sensitivity in tooth, hinderance in mastication and prolonged orthodontic treatment (p<0.001).

Does the patient experience any form of relapse after treatment?	No	80	32.1	<0.001**
	Yes	169	67.9	

Statistically significant association was found between relapse after treatment and prolonged orthodontic treatment (p<0.001).

Does it cause cheek biting?	No	107	43.0	0.027*
	Yes	142	57.0	
What impact the treatment had on	No effect	46	18.5	<0.001**
	Positive effect	187	75.1	

boosting your overall self-esteem and confidence?	Negative effect	16	6.4	

Cheek bite exhibited a statistically significant association with prolonged orthodontic treatment (p=0.027).
Positive impacts on self-esteem and confidence were significantly linked to prolonged orthodontic treatment (p<0.001).

Reason for orthodontic treatment	Aesthetics	1	.4	<0.001**
	Over crowding	60	24.1	
	Prognathic or retrognathic occlusion	77	30.9	
	Deep bite or cross bite	98	39.4	
	Any other	13	5.2	

Overcrowding, prognathic or retrognathic occlusion, deep bite, or crossbite as treatment purposes showed a statistically significant association with prolonged orthodontic treatment (p<0.001).

How did it affect your mouth opening?	No effect	77	30.9	<0.001**
	Decreased	53	21.3	
	Increased	119	47.8	
What impact the treatment had on boosting your overall confidence and self-esteem?	No effect	44	17.7	<0.001**
	Huge impact	126	50.6	
	Moderate effect	79	31.7	

Have you experienced any 2 on your oral hygiene routine during prolonged orthodontic treatment?	No	100	40.2	0.019*
	Yes	85	34.1	
	Not sure	64	25.7	

Mouth opening demonstrated a statistically significant association with prolonged orthodontic treatment (p<0.001).
Improved mastication displayed a statistically significant association with prolonged orthodontic treatment (p<0.001).

Impact on daily life routine was significantly associated with prolonged orthodontic treatment (p<0.001).

Have you noticed any changes in your ability to chew or eat certain foods since starting of orthodontic treatment?	No	60	24.1	<0.001**
	Yes	175	70.3	
	Not sure	14	5.6	
Do you feel that the duration of your orthodontic treatment has impacted your daily life or caused any inconvenience?	Agree	94	37.8	<0.001**
	Strongly agree	110	44.2	
	Disagree	41	16.5	
	Strongly disagree	4	1.6	
Have you noticed any	No	72	28.9	<0.001**

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changes in your bite or jaw alignment during the course of your orthodontic treatment?	Yes	163	65.5	
	Not sure	14	5.6	
How do you rate your overall satisfaction with the results of your orthodontic treatment?	Very satisfied	59	23.7	<0.001**
	Somewhat satisfied	143	57.4	
	Neutral	36	14.5	
	Somewhat dissatisfied	9	3.6	
	Very dissatisfied	2	.8	

Changes in bite or jaw alignment during orthodontic treatment exhibited a statistically significant association with prolonged treatment duration ($p<0.001$).
Patient satisfaction with treatment significantly correlated with prolonged orthodontic treatment ($p<0.001$).

Almost all the components of the Experience and the Impact were significantly associated with Prolonged orthodontic treatment $p<0.001$.

Few areas of the experience were not statistically significant like did you observed any white spots/bands on your cheek? did you observed any painful red lesions under the lip? Did you observed white spots on your teeth after braces/brackets removal?

IV. DISCUSSION -

In the realm of orthodontics, there has been a longstanding acknowledgment that malocclusion and dentofacial irregularities can lead to significant physical, social, and psychological distress.

In this study, we reflected light on the prolonged effect of orthodontic treatment on the oral health status of these patients. The survey highlight the multifaceted impact of prolonged orthodontic treatment on various aspects of oral health, daily life, and psychological well-being.

The study involved 250 participants, where across the genders, the distribution was almost evenly balanced, with males accounting for 49.8% and females for 50.2% of participants. According to a previous study by Ramesh Nagarajappa et al, the influence of gender on impact of fixed appliances was also low[1] . The significance of dental aesthetics appears to hold greater concern for women, compared to men. Hence potentially contributing to lower discontinuation rates among girls and longer treatment time.

The survey analyzed the demographic composition of participants undergoing orthodontic treatment. Notably, the majority of respondents (69.5%) were within the 21-30 age group, suggesting a higher prevalence of orthodontic interventions among younger individuals. Conversely, only a small percentage fell within the older age brackets (>30 years). This skewed distribution implies that orthodontic treatment is predominantly sought by younger individuals, possibly due to aesthetic concerns or dental issues addressed during early adulthood. The duration of orthodontic treatment varied significantly among respondents. There is not much literature with which to compare the effect of age on fixed appliance impact. However, according to Ramesh Nagarajappa, younger patients have lower treatment discontinuation rates [1].

Moreover, 50.6% reported brushing their teeth twice a day, while only 20.9% brushed once daily. These findings align with a survey conducted by Jin Han Lee and et al, stating all patients used toothbrush and most of them brushed at least twice daily[3]. Participants' oral hygiene practices during orthodontic treatment varied. While a significant portion (50.6%) brushed twice daily, a substantial number (18.1%) rinsed after every meal. This research revealed that the majority of participants utilized toothbrushes and practiced brushing their teeth at least twice a day.

However, a concerning percentage (20.9%) only brushed once daily, and a minority (10.4%) utilized interdental brushes or mouthwash. Dalal Tareq et al. and Lee et al. indicated higher percentage of participants using interdental brush (88.6%) and mouthwash 64% respectively [2][3].

These findings underscore the need for reinforcing consistent and thorough oral hygiene practices, especially during orthodontic treatment, to mitigate potential oral health issues. Several challenges were reported by respondents during prolonged orthodontic treatment.

A considerable majority (69.1%) experienced difficulty in cleaning fixed appliances due to food lodgment. Patients also complaint the need to change their diet in order to avoid food impaction and eating discomfort. According to the survey conducted by Azrul Hafiz and et al, the

highest complaint during wear of fixed appliance was difficulties in eating with 76.5% patients had difficulties to consume food. Apart from that, 41.2% patient's complaint of their meal routine being interrupted where they were forced force to change their diet; due to food lodgment.

Additionally, a significant percentage (59.0%) reported occasional ulceration in the mouth, while 31.7% experienced frequent ulceration, highlighting discomfort associated with treatment. Usually the residual arch wire or long uncut arch wire led traumatic ulcers. Baricevic et al. reported that orthodontic brackets tended to cause mucosal erosions and desquamations whereas arch wires caused ulcerations [5]. This finding is in line with the previously reported studies by Abdul Baseer and et al and Shalish M and et al , stating fixed orthodontic patients had a higher incidence of mucosal sores on the lips, tongue, and cheeks due to the use of metal brackets, wires, and bands. [6][7].

Regarding sensitivity following the application of orthodontic appliances, a notable majority (61.4%) reported experiencing sensitivity, while a minority (38.6%) did not. This substantial difference in percentages suggests that sensitivity is a common outcome after orthodontic appliance placement. A systematic review by Golež A and et al, confirmed that orthodontic tooth movement could negatively impact the sensitivity of the dental pulp. Orthodontic tooth movement increased the EPT threshold and the risk of a negative pulpal sensitivity test[12].

Notably, changes in facial profile were observed by 7.6% with significant changes, 20.9% with moderate changes, and 55.0% with minimal changes, indicating diverse aesthetic impacts. Concerning facial transformations, the protrusion of lips, during orthodontic procedures emerged as a predominant worry among the majority of patients. The corrective device often results in the upper lip appearing more prominent, causing self-consciousness about one's smile. Additionally, many individuals reported experiencing discomfort during conversations and difficulties achieving complete mouth closure due to the impediment caused by braces on the upper lip. As per the findings presented by Hou, S.Y., Zhou, W., Dai, H. et al., their study highlighted the presence of protruded lips following orthodontic treatment, noting a greater extent of protrusion in the lower lip when compared to the upper lip within the labial region[9].

Moreover, 37.8% agreed, and 44.2% strongly agreed that the treatment impacted their daily life or caused inconvenience, emphasizing the significant lifestyle adjustments and potential discomfort associated with prolonged treatment. Eating, speaking, and smiling were the daily performances most commonly affected , aligning with prior discoveries by Sergl et al.[11] and Mandall et al.[12]; Sergl et al.[11] noted that biting and chewing became notably discomforting during the initial week following the insertion of orthodontic appliances. Furthermore, they highlighted that the primary short- and long-term effects of wearing these appliances manifested in speech impediments, swallowing difficulties, and a decreased sense of confidence in social settings. Similarly, Mandall et al.[12] underscored that orthodontic treatments led to implications not only concerning aesthetics but also functional limitations.

Following orthodontic treatment, the phenomenon wherein teeth and jaws gradually revert to their initial positions is termed "relapse." This reversion can occur due to multiple factors, including inadequate use of retainers, insufficient duration of retention, suboptimal occlusal alignment, occlusal stress, the eruption of third molars, and lingering poor oral habits that were not entirely corrected during treatment. The data on relapse post-treatment indicates a noteworthy trend. A significant majority (67.9%) reported experiencing some form of relapse after orthodontic treatment, while a smaller percentage (32.1%) did not encounter any relapse. This result emphasizes that a considerable proportion of patients may face challenges related to maintaining the treatment outcome achieved through orthodontic procedures. A prior study done by Wang T and et al, addressing the same concern, reported the proportion of patients who thought they had a phenomenon of obvious relapse were 23.12% [13].

Regarding treatment outcomes, while a majority (57.4%) expressed some level of satisfaction, a notable portion reported dissatisfaction (3.6% somewhat dissatisfied, 0.8% very dissatisfied). The literature lacks a conclusive outcome regarding patient satisfaction with orthodontic treatment. This could be attributed to the varying motivations and expectations among individuals undergoing orthodontic procedures. Study done by Al Omiri et al, reported functional, esthetic, and social reasons as the main motives to seek orthodontic treatment [8]. Another survey by Abu Younis states Personality profiles (neuroticism; extraversion; openness; agreeableness and conscientiousness) may influence dental perceptions; play a significant role in shaping satisfaction with dentition, and help with

prediction of dental impacts on daily living[18]. Mahmoud Al Omiri also reported that " Personality traits were found to be correlated with patients' satisfaction with their dentition after orthodontic treatment. Elevated neuroticism scores exhibited a notable adverse correlation with overall satisfaction concerning the dentition (P < .05) [8].

This survey has showcased light onto some of the main impacts of orthodontic treatment by way of an overview of relevant research. It is evitable that the impact of orthodontic treatment vary between individuals and treatment plans. Clinicians should develop treatment plans in light of an assessment of their patients' susceptibility to these risks and patients should be duly informed of these risks as part of informed consent. Achieving this demands a certain level of expertise and proficiency from the clinician. Consequently, adopting a treatment approach based on a "one size fits all" philosophy could potentially increase the likelihood of patients facing more adverse consequences.

V. CONCLUSION :

Orthodontic treatments have profound effects on oral health, daily life, and psychological well-being, evident from our study involving 200 participants. Challenges during prolonged treatment include difficulty in cleaning fixed appliances, oral ulcers, sensitivity, and diverse aesthetic changes, necessitating consistent oral hygiene practices. Daily life is significantly impacted, causing inconvenience in activities like eating, speaking, and smiling, and a considerable proportion experiences post-treatment relapse.

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