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Indirectly Printed Thermoformed Aligners- Oral Health Related Quality of Life: A Mini Review

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ABSTRACT
Clear aligner is an advanced orthodontic method with benefits of comfort, aesthetics, and convenience. This review describes the pain perception, and impacts on oral health-related quality of life (OHRQoL) of adult patients receiving clear aligners for orthodontic treatments. As more and more patients are opting for clear aligners over the conventional fixed appliance therapy patient's perception of pain and comfort regarding the aligners becomes extremely important. Therefore, proper evaluation regarding the pain perception and comfort and Oral health related quality of life during the orthodontic treatment with clear aligners must be evaluated. The present mini review aims to summarize the studies in the literature regarding the pain, tissue irritation, fit of the clear aligners. It was concluded that pain perception with clear aligners was lesser than fixed appliances, discrepancy in the fit of the aligners will not lead to desired tooth movement. In general, greater comfort was offered by clear aligners than fixed appliance therapy.

KEYWORDS
Clear Aligners, CAT, Clear Aligner Therapy, Ohrqol, Indirectly Printed Aligners, Pain Perception, Comfort, Durability

INTRODUCTION
Today's patients may experience increased worry and anxiety because to their increased awareness of any postoperative symptoms associated with dental procedures. Patients frequently suffer varying degrees of pain, discomfort, and worry during the early phases of any orthodontic treatment, which can interfere with everyday activities like eating and sleeping[1,2]. Greater anxiety levels have been associated with more painful and long-lasting postoperative periods.[3] In the dental field, "Oral Health-Related Quality of Life" (OHRQoL) focuses on

quality of life linked to oral health.[4,5,6] The OHRQoL reflects people's comfort when eating, sleeping and engaging in social interaction; their self-esteem; and their satisfaction with respect to their oral health. The literature presents various tools aimed at quantifying OHRQoL by estimating patient difficulties associated with discomfort, pain, mastication difficulties, speech disturbances and social impairments[5,7,8,9,10]. OHRQoL scores during orthodontic treatment seem to be negatively affected by physical discomfort, pain, functional problems, and psychological issues.[11,12] Nevertheless, these scores improve substantially with time. CAT is becoming increasingly popular among patients seeking orthodontic therapy. However, this system has serious limitations regarding the accuracy of expected tooth movements compared to conventional fixed appliance orthodontic treatment.[13] Studies on CAT have shown better patient-reported experiences in oral hygiene, comfort, esthetics, pain, periodontal status, patient chair-time and overall treatment time.[13,14,15,16] Another recent study evaluated OHRQoL and oral hygiene in adolescents during the first year of aligner therapy. They found that OHRQoL was only slightly affected and that oral hygiene at home was intensified.[17] However, the type of appliance used influences the pain and quality of life of patients at the start of orthodontic treatment.[18]

When comparing quality of life (QoL) between patients treated with fixed appliances and Invisalign (Align Technology, San Jose, CA), it was observed that both presented similar QoL results, except under the category of eating and chewing where the aligner group showed better results.[19]

PAIN, TISSUE IRRITATION

Pain is a subjective response and presents a large number of individual variations under the same trigger conditions. It depends on several factors such as age, sex, individual pain threshold, emotional state, stress, amount of applied force, cultural differences, and previous experiences of pain.[20,21] Pain complaints are a common feature during orthodontic treatment [22] directly influencing patient's satisfaction.[23] It is one of the main reasons for orthodontic treatment discontinuation.[24] It is well known that during orthodontic treatment with fixed appliances, it is common to feel pain and discomfort[25], reaching its peak 24 h after arch insertion, and being almost imperceptible 7 days after.[26,27] However, the type of the appliances may have an influence on the pain and discomfort reported by the patients due to the type of force applied. Removable appliances produce intermittent forces, which allow the tissues to reorganize before compressive forces are reapplied.[28] Regarding studies that have evaluated pain levels with clear aligners compared to fixed appliances, some studies have found positive [21,29,30] or negative[31] results related to clear aligners. Almasoud et al[14] compared the pain perception between self- ligating Damon's bracket system and clear aligners and found that Patients treated with Invisalign observed lower pain than did with braces. Increase of pain was experienced at 24 h and decrease at day 7 in both groups.

Mais-Damois et al[32] found similar results regarding pain comparison between clear aligners and fixed appliance, they also found that the tissue irritation was lesser for aligners. These results of pain perception were also in agreement with Miller et al[30], White et al[21]. Shalish et al[31] compared OHRQL of lingual appliances with clear aligners, it was found that lingual appliance was associated with more severe pain and analgesic consumption, increase in oral and general dysfunction, and the most difficult and longest recovery. Long term comparison of 6 months was performed by Chan et al[33] for orthodontic pain comparison between fixed appliances and clear aligners, similar amount of pain was found in the 1st 2 days of both the groups. The clear aligner pain remained minimal, fixed appliance pain peaked 2 days post appointments and remained elevated till 7 days when new arch wire was used.

ACCURACY AND FIT

In dentistry, dimensional accuracy is a common research topic since many dental prostheses need to fit precisely to increase longevity and lower the chance of oral pathology.[34] There are many ways to evaluate dimensional correctness. Three techniques have been used to evaluate the dimensional accuracy of thermoplastic dental materials intended for use in retainers: micro-CT[37], optical scanners[36], and computer coordinate machines.[35] Once a model's volume and the volume that each retainer encloses have been measured, they are sent into a computer software that uses a best-fit function to align the volumetric renderings and digitally measures the distances between the retainers at pre-selected reference points. Literature shows that the accuracy of aligner fit have reported average discrepancies far beyond the ranges of clinical acceptability. Mantovani et al.[38] measured the aligner gaps of two commercially available aligner systems by using scanning electron microscopy and found average discrepancies ranging from 0.102 mm to 0.351 mm. Lombardo et al.[7] investigated the measurements of aligner gaps of five commercially available aligner systems using micro-computed tomography (micro-CT) scans and found discrepancies ranging from 0.047 mm to 0.651 mm. If the discrepancy between the aligner and the tooth is greater than 0.25 mm at a site where 0.25 mm movement is prescribed, no clinically appreciable tooth movement will occur. This discrepancy of fit could be a potential cause for the lack of movement accuracy of up to 57% in some planned orthodontic movement. Less information is available regarding the dimensional accuracy of aligners or retainers. Cole et al.[39] compared the dimensional accuracy of thermoformed retainers versus direct-printed retainers and found that direct-printed retainers had greater discrepancies. They used optical scanning and metrology software to assess accuracy at specific landmarks and found average discrepancies ranging from 0.1 mm to 0.3 mm for thermoformed retainers and 0.1 mm to 0.4 mm for direct-printed retainers. Jindal et al.[40] evaluated the geometrical accuracy of direct-printed aligners and found that crown heights were more accurate than those of their thermoformed counterparts. While the average discrepancy in thermoformed aligners was 0.37 mm, the corresponding value for direct-printed aligners was 0.21 mm which was in contrast with the study by Cole et al.[39] Prior to this study, the dimensional accuracy of direct-printed aligners had not been thoroughly evaluated.

COMFORT

Flores-mir et al[41] conducted a cross-sectional study comparing conventional fixed appliances and clear aligners and assessed dental impacts on daily living via a patient satisfaction questionnaire. It was found that patients were better satisfied being treated with clear aligners when chewing and eating were concerned. Both groups treated patients had statistically similar satisfaction outcomes, except for eating and chewing

In a study by Fujiyama et al[42] comparing the clear aligners with the Edgewise straight wire found that the intensity of pain was lesser with aligners but this study questioned the durability of the aligner as problems such as tray deformation were found and hence must be checked.

CONCLUSION

Pain perception of the patients using Clear aligners as a mode of treatment was lesser than patients with fixed labial (edgewise, MBT, self ligating) and lingual appliances. Tissue irritation with fixed appliances was greater than clear aligners.

Poor aligner fit with greater discrepancy between the tooth surface and the aligner will result in no tooth movement.

Patients were overall better satisfied with the treatment with clear aligners when compared with fixed appliances.

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