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"COMPARATIVE EVALUATION OF THE DIFFERENCE IN THE RATE OF INDIVIDUAL CANINE RETRACTION IN MAXILLARY ARCH FOLLOWING MICRO OSTEOPERFORATION WITH TWO DIFFERENT TECHNIQUES."

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ABSTRACT:

Background: Orthodontic tooth movement is a time-consuming process that can be a concern for both patients and practitioners. Micro Osteoperforation is an emerging technique that may accelerate tooth movement by inducing localized alveolar microtrauma. This study aimed to compare the effectiveness of Micro Osteoperforation using Temporary Anchorage Devices and Bone Drilling Bur on the rate of canine retraction in the maxillary arch.

Method: A clinical trial was conducted involving 28 patients with bimaxillary protrusion requiring upper first premolar extraction. Two groups were formed, one with receiving Micro Osteoperforation with Temporary Anchorage Devices and the other with Bone Drilling Bur. Canine retraction rates were measured monthly for eight months using digital vernier calipers.

Outcome of the study: The study demonstrated that MOP significantly increased the rate of canine retraction in the experimental groups compared to the control groups. However, there were no statistically significant differences between the Temporary Anchorage Device and Bone Drilling Bur methods.

Conclusion: Microsteoperforation, whether performed with Temporary Anchorage Devices or Bone Drilling Bur, proved to be an effective method for accelerating canine retraction in the maxillary arch. This has clinical implications for reducing orthodontic treatment duration and improving patient comfort. Further research is recommended using more extensive sample sizes and extended follow-up periods to confirm and build upon these findings.

Keywords: *Orthodontics, Micro Osteoperforation, Bone Drilling Bur, Canine Retraction, Accelerated Tooth Movement.*

INTRODUCTION

Orthodontics is a field of dental care that has seen significant advancements in recent years. One of the key concerns for orthodontic patients, especially adults, is the duration of treatment. In response to this, patients have sought alternative treatment options, such as implants,

composite restorations, veneers, and fixed prostheses, to complete their treatment more quickly. To address this demand, orthodontists have explored techniques to accelerate tooth movement without compromising treatment outcomes. Wilckodontics, introduced by the Wilcko brothers, is one such technique that involves surgical intervention to stimulate rapid orthodontic tooth movement through a process known as the Rapid Acceleratory Phenomenon (RAP).[1]

RAP is initiated through full-thickness mucoperiosteal flap elevation, vertical cortical incisions, and a sub-apical horizontal osteotomy. While Wilckodontics has shown favorable results, it is an invasive procedure associated with potential disadvantages, including damage to adjacent vital structures, interdental bone loss, and high morbid[ity.[2]] In response, alternative techniques like piezo Cision and corticision were introduced but carried the risk of root injury and flap damage. Non-invasive approaches, including low-level laser therapy and vibration impulses, have also been explored.[3]

Pharmacological agents like vitamin D, parathyroid hormone, interleukin, and misoprostol have been investigated for their potential to accelerate tooth movement. However, these agents have presented challenges such as side effects and root resorption. The application of orthodontic force triggers inflammatory pathways marked by the release of chemokines and cytokines, leading to bone resorption and tooth movement. Building on this principle, Micro-Osteo Perforations (MOPs) have been proposed as a minimally invasive technique to amplify the inflammatory response and accelerate tooth movement.[3]

Alikhani and colleagues tested this hypothesis through animal models and clinical trials, demonstrating that MOP treatment significantly increased tooth movement without causing pain or discomfort.[4] However, the evidence base for MOPs remains limited and contradictory, with more recent studies questioning their effectiveness.[5] This study aims to evaluate the impact of MOPs on individual canine retraction in the maxillary arch using two different techniques and comparing them to contralateral normal orthodontic tooth movement.

METHODOLOGY

In this study, an In-Vivo Randomized Clinical Trial was conducted to investigate variations in the rate of individual canine retraction within the maxillary arch when employing two different Micro osteoperforation techniques and comparing them to conventional orthodontic tooth movement. The research study spanned one year, from November 2020 to December 2021

included 28 patients aged 16 to 30 years who sought fixed appliance therapy at the Department of Orthodontics and Dentofacial Orthopedics.

Sample size calculations were based on previous research by Mani Alikhani et al., and simple random sampling was employed. Inclusion criteria encompassed patients willing to undergo fixed appliance therapy, aged 16-30 years, requiring bilateral maxillary first premolar extraction, and having a minimum of 5mm of available extraction space before maxillary permanent canine retraction. Exclusion criteria included a history of previous orthodontic treatment, craniofacial anomalies, periodontal diseases, specific medication usage, poor oral hygiene, systemic diseases, bone loss, past periodontal diseases, smoking, and dental issues. Ethical clearance was obtained, and informed consent was secured from all patients. Treatment procedures involved micro osteoperforation using orthodontic mini-implants in one group and bone drilling burs with a Physio Dispenser in the other. Measurements and statistical analyses were conducted to assess the outcomes.

Statistical analysis:

Statistical analysis was carried out using IBM SPSS Statistics 25, a statistical software package from IBM based in Armonk, New York, United States. The analysis involved the application of specialized statistical tests to determine the statistical significance of the collected data. The choice of specific statistical tests was determined by the characteristics and nature of the data under investigation. Significance was assessed at a 5% level, meaning that a p-value of less than 0.05 was considered indicative of statistical significance.

RESULTS

The experimental group, treated with Micro Osteoperforation via Temporary Anchorage Device, showed consistently higher mean retraction values compared to the control group at different time intervals. Statistical analysis (indicated by p values) revealed significant differences in retraction rates between the groups at each time point, except in the 7th month. The asterisks (*) denote statistically significant differences ($p < 0.05$). (Table 1)

In the experimental group comprising 14 participants, the average canine retraction decreased from 1.09mm in the first month to 0.83mm in the sixth month. In contrast, the control group, also consisting of 14 participants, displayed a reduction from 0.91mm to 0.73mm during the same period. Statistical analysis revealed significant differences in retraction rates between the groups at each monthly interval, as denoted by the asterisks (*). The differences remained

significant even in the seventh month when the experimental group had 9 participants, with an average retraction of 0.82mm, while the control group, comprising 14 participants, exhibited an average retraction of 0.73mm. Notably, in the eighth month, no data was available for the experimental group, while the control group, consisting of 5 participants, showed an average retraction of 0.73mm. (Table 2)

The table compares two groups, Groups A and B, over an 8-month period. In the first month, Group A had a mean value of 1.14 with a standard deviation of 0.32, while Group B had a mean of 1.09 with a standard deviation of 0.29. Over the following months, both groups exhibited decreasing mean values. The differences between the groups were statistically analyzed, with p-values indicating the significance of the observed differences. Notably, in the later months, both groups showed similar mean values, and the study concludes with limited data available for Group A in the final month. Table 3)

In the Temporary Anchorage Device group, the average monthly canine retraction rate was 0.87mm on the experimental side and 0.73mm on the control side, with a significant difference observed between the two sides. Similarly, in the Bone Drilling Bur group, the average monthly canine retraction rate was 0.89mm on the experimental side and 0.76mm on the control side, with a significant difference noted between these sides as well. However, there was no significant difference in the average monthly canine retraction rate between the Temporary Anchorage Device group and the Bone Drilling Bur group. (Table 4)

DISCUSSION

This study used two different techniques to assess the difference in the rate of individual canine retraction between Micro Osteoperforation (MOP) and normal orthodontic tooth movement in the Department of Orthodontics and Dentofacial Orthopaedics.

Previous research by **Alikhani et al.**[4] suggested that MOPs may increase the movement of teeth during canine retraction, potentially reducing overall orthodontic treatment time. To minimize the impact of occlusal forces on tooth movement, the study only included patients with similar types of malocclusions, excluding those with crossbites or deviations caused by occlusal interference.

MOPs were randomised to be placed on the left or right side of each patient in order to rule out the possibility of unequal occlusal forces. Three MOPs were integrated within the extraction socket's central area, positioned slightly behind the canine, at different heights from the gingival margin. The concept of Regional Acceleratory Phenomenon (RAP), as proposed by

Wilcko et al.,[6] was considered, which suggests an increase in the rate of tooth movement through osteoblastic and osteoclastic activity at the site of injury.

MOPs were chosen as a minimally invasive alternative to more invasive techniques, such as the Periodontally Accelerated Osteogenic Orthodontics (PAOO) technique. The study used Alginate impressions before and after canine retraction, along with occlusal photographs taken monthly to monitor the rate of tooth movement. Measurements were taken with an electronic digital caliper to minimize errors.

In the Temporary Anchorage Device group, the average rate of canine retraction per month was higher in the experimental group (0.87 mm) than in the control group (0.73 mm), and the difference was statistically significant. This finding aligned with a study **by Massod et al.**[7]

In opposition to **Alkebsi et al.'s**[8] findings, which indicated no notable distinction in the pace of canine retraction between the experimental and control groups, this research revealed a considerable variance in the rate of tooth movement between the MOP groups and the control group. In contrast to our result, **Amira Abolnaga et al.,**[9] showed a divergent result of no statistically significant differences in the rate of canine retraction between the experimental and control group.

In the group utilizing Micro Osteoperforation through Bone Drilling Bur, the mean monthly rate of canine retraction stood notably higher in the experimental group (0.89 mm) compared to the control group (0.76 mm), demonstrating a statistically significant difference. This outcome aligns with findings from research conducted by **Stephy Thomas et al**.[10]

When comparing the two MOP techniques, the research revealed a relatively higher rate of canine retraction on the experimental side within the Bone Drilling Bur group in contrast to the Temporary Anchorage Device group; however, this variance did not reach statistical significance.

The study considered various factors that might affect the rate of tooth movement, including age, sex hormones, medications, oral hygiene, and anchorage. Mini implants were used for anchorage, and the Micro Implants had specific dimensions that were selected based on previous research.

CONCLUSION

The consistent findings of the study revealed that Micro Osteoperforation significantly accelerated canine retraction in the Experimental groups when compared to the Control groups. This implies that Micro Osteoperforation is an effective means to expedite orthodontic tooth movement, potentially shortening treatment duration and improving patient comfort.

Moreover, among the Experimental groups, it seemed that the Bone drilling bur technique could potentially provide a slightly elevated rate of canine retraction in comparison to the Temporary Anchorage Device method. Nonetheless, this distinction lacked statistical significance, suggesting that both methods effectively enhance rates of canine retraction.

Overall, this study provides valuable insights for orthodontic practitioners and researchers, highlighting Micro Osteoperforation as a beneficial adjunct to orthodontic treatment. The choice between the two methods may depend on clinical preferences and patient-specific factors. Additional studies involving increased sample sizes and extended follow-up durations might be necessary to validate these results and investigate potential variations in treatment outcomes. Nevertheless, this study underscores the potential for enhancing orthodontic procedures and, ultimately, patient satisfaction with shorter treatment durations.

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TABLES:

Table 1: Differential Canine Retraction Rates between Experimental and Control Groups Using Micro Osteoperforation via Temporary Anchorage Device (Group A)

Interval	Groups	N	Mean	SD	Difference	p value
1 Month	**Experimental**	14	1.14	0.32	0.18	0.047*
	Control	14	0.96	0.11		
2 Month	**Experimental**	14	0.89	0.11	0.19	0.001*
	Control	14	0.70	0.12		
3 Month	**Experimental**	14	0.79	0.11	0.08	0.039*
	Control	14	0.71	0.09		
4 Month	**Experimental**	14	0.81	0.11	0.11	0.018*
	Control	14	0.70	0.11		
5 Month	**Experimental**	14	0.81	0.09	0.11	0.004*
	Control	14	0.70	0.11		
6 Month	**Experimental**	14	0.81	0.05	0.12	0.001*
	Control	14	0.69	0.07		
7 Month	**Experimental**	9	0.80	0.09	0.11	0.21*
	Control	14	0.69	0.12		
8 Month	**Experimental**	1	0.80	.	0.13	0.401
	Control	6	0.67	0.14		

Independent t test; * indicates significant difference at $p \leq 0.05$

Table -2: Differential Canine Retraction Rates between Experimental and Control Groups Using Micro Osteoperforation with Bone Drilling Bur (Group B).

Interval	Groups	N	Mean	SD	Difference	p value
1 Month	Experimental	14	1.09	0.29	0.18	0.044*
	Control	14	0.91	0.13		
2 Month	Experimental	14	0.89	0.09	0.14	0.001*
	Control	14	0.75	0.05		
3 Month	Experimental	14	0.85	0.07	0.10	0.004*
	Control	14	0.75	0.10		
4 Month	Experimental	14	0.85	0.09	0.11	0.009*
	Control	14	0.74	0.12		
5 Month	Experimental	14	0.84	0.12	0.09	0.039*
	Control	14	0.75	0.09		
6 Month	Experimental	14	0.83	0.07	0.10	0.008*
	Control	14	0.73	0.11		
7 Month	Experimental	9	0.82	0.06	0.09	0.036*
	Control	14	0.73	0.12		
8 month	Experimental	0	.	.	--	--
	Control	5	0.73	0.11		

Independent t test; * indicates significant difference at $p \leq 0.05$

Table-3 illustrates the variance in individual canine retraction rates between the experimental groups undergoing Micro Osteoperforation with Temporary Anchorage Device (Group A) and Bone Drilling Bur (Group B).

Interval	Groups	N	Mean	SD	Difference	p value
1 Month	Group A	14	1.14	0.32	0.05	0.621
	Group B	14	1.09	0.29		
2 Month	Group A	14	0.89	0.11	0.01	1.000
	Group B	14	0.89	0.09		
3 Month	Group A	14	0.82	0.11	-0.03	0.432
	Group B	14	0.85	0.07		
4 Month	Group A	14	0.78	0.11	-0.07	0.066
	Group B	14	0.85	0.09		
5 Month	Group A	14	0.81	0.09	-0.03	0.499
	Group B	14	0.84	0.12		
6 Month	Group A	14	0.81	0.05	-0.02	0.449
	Group B	14	0.83	0.07		
7 Month	Group A	9	0.80	0.09	-0.02	0.598
	Group B	9	0.82	0.06		
8 Month	Group A	1	0.80	--	--	--
	Group B	0	--	--		

Table-4: Comparison of Average Rate of Canine Retraction Table 7

Group	Groups	N	Mean	SD	Difference	p value
Group A	**Experimental**	14	0.87	0.08	0.14	0.001*
	Control	14	0.73	0.04		
Group B	**Experimental**	14	0.89	0.06	0.13	0.001*
	Control	14	0.76	0.03		
Experimental	**Temporary anchorage device**	14	0.87	0.08	-0.02	0.592
	Bone drilling bur	14	0.89	0.06		

Independent t test; * indicates significant difference at p≤0.05

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