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RESEARCH ARTICLE

ACCELERATED ORTHODONTICS: AN ANSWER TO FAST PACED LIFE.

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Introduction:-

Shorter duration of orthodontic treatment is the need of the hour in current practice as huge number of adults demand results within short span of time. As a result, there is an increased number of researches focusing on methods that accelerate orthodontic tooth movement. Longish orthodontic treatment time poses several disadvantages like higher predisposition to caries, gingival recession and root resorption. There exists a void in research as to which is the best method to increase tooth movement with minimal disadvantages. Currently, mechanical force is used to achieve tooth movement. The periodontal tissues surrounding the teeth are remodelled to achieve the necessary tooth movement. However, these biomechanical systems may have their own limitations in terms of treatment duration and tooth movement. This signals towards development of newer approaches. Various attempts that include biological, physical and surgical approaches have been studied clinically. But a lot of uncertainties surround the application of these techniques. Hence, the purpose of this study is to review various successful methods for the accelerated orthodontic tooth movement and establish the best method for clinical practice.

Prostaglandins (PGE):-

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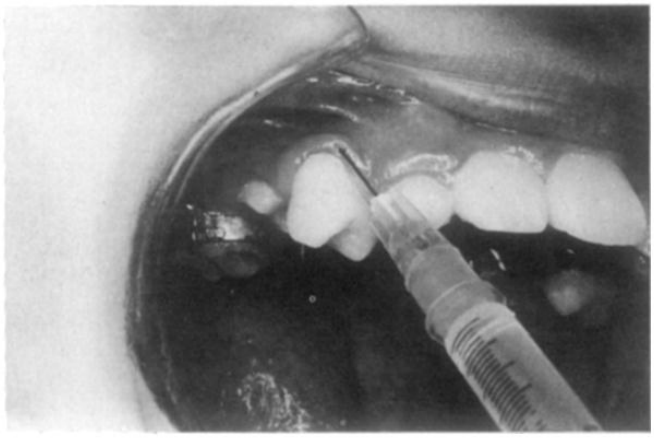

Fig. 1:- Prostaglandins.

There was an increased tendency among the researchers to investigate the role of prostaglandins in bone resorption associated with orthodontic tooth movement in eighties. Yamasaki et al conducted experiments on rats to investigate whether the synthesis of prostaglandins is induced by orthodontic force, and whether exogenous prostaglandins can produce bone resorption similar to orthodontic force. They reported that the application of orthodontic force did indeed cause increased synthesis of prostaglandins, which in turn stimulated osteoclastic bone resorption.

Local administration of PGE, (10 mg per site) in gingiva near the orthodontically treated teeth caused almost double the rate of tooth movement seen on the vehicle-injected side. Macroscopically and roentgenographically, no side effects were observed in the gingiva. The results of this study showed that local injection of PGE, may be a safe and effective, clinically applicable method of accelerating orthodontic tooth movement.[1,2]

Cytokines:-

A study done by h. Kanzaki et al showed that opg gene transfer to the periodontal tissue inhibited RANKL-mediated osteoclastogenesis induced by mechanical stress, and inhibited experimental tooth movement, without eliciting any systemic effects. Osteoclastogenesis in response to orthodontic tooth movement appears to be regulated primarily through RANKL signaling in periodontal cells.[3]

Another study demonstrated that transfer of the RANKL gene to the periodontal-tissue activated osteoclastogenesis and accelerated the amount of experimental tm. Local RANKL gene transfer might be a useful tool not only for shortening orthodontic treatment, but also for moving ankylosed teeth where teeth, fuse to the surrounding bone.[4]

Surgical approaches:-

Corticotomy:-

Fig 2:- Corticotomy[31]

Corticotomy has been used in many of the orthodontic treatment or orthognathic surgery. Kole reported combining orthodontics with corticotomy surgery and completed the active tooth movement in adult orthodontic cases in 6--12 weeks.[7]

Orthopaedist Harold Frost termed this as the regional acceleratory phenomenon (RAP).[8,9] In RAP there is temporary burst of localized soft and hard tissue remodeling (i.e., regeneration) which rebuilds the bone back to its normal state.[10]

Corticotomy-facilitated orthodontics (CFO) can be an effective method for patients who desire shortened orthodontic treatment durations. The Luebke-Ochsenbein flap design can be a feasible and an applicable corticotomy flap design. Miniscrew implants can function as a viable molar anchorage tool. They are simple and efficient anchors for canine retraction, especially in moderate to maximum anchorage situations.[6]

Surgically facilitated tooth movement is a process of demineralization-remineralization and suggest that selective alveolar decortication induces a localized increased turnover of alveolar spongiosa and that demineralization-remineralization is the likely biologic mechanism underlying rapid tooth movement associated with selective alveolar decortication. The role of coupled osteoclastic and osteoblastic activity in response to alveolar decortication through which the orthodontic tooth movement is enhanced, is evident[5].
While the surgical intervention during the orthodontic treatment may not always be desired, understanding the biologic mechanism underlying the bone turnover and the change in dynamics of tooth movement as a result of the increased bone activity are critical for designing novel treatment methods in the future.[5]

Piezocision:-

Fig 3:-Piezocision

Piezocision is an innovative, minimally invasive technique designed to achieve rapid orthodontic tooth movement without the downside of extensive and traumatic conventional surgical approaches. This new technique can be combined with various orthodontic treatment modalities to satisfy today's adult patient population, and modifications can be made to meet the specific mechanical requirements.[12]

Piezocision involves gingival microincisions and vertical cortical cuts without flap reflection. The piezotome can be used to remove the bundle bone from the wall of the extraction socket to decrease the resistance to tooth movement in the desired direction. Piezocision is 1.5 times faster than conventional orthodontics.[11]

A study conducted to compare the extent of canine distalization and the transversal changes, postdistalization gingival indices, and mobility scores between patients who were undergoing orthodontic treatment involving upper premolar extraction with (experimental group) or without piezocision showed that Piezocision accelerates tooth movement, decreases the anchorage loss for posterior teeth, and does not induce any maxillary transversal change. Moreover, piezocision does not have any adverse effects on periodontal health.[13]

Wilkodontics:-
Wilcko reported that the acceleration of tooth movement is not due to the bony block movement as postulated by Kole[7]; it was rather a process of bone remodeling at the surgical site, which was called regional acceleratory phenomenon (RAP). He developed patent techniques which were called accelerated osteogenic orthodontics (AOO)

and periodontal accelerated osteogenic orthodontics (PAOO).[14] This technique is reported to have postoperative stability and improved retention.[18].

The main disadvantage of these surgical approaches is their invasiveness and the acceleration was only in the first 3 to 4 months and it declines with time to the same level of the conventional technique[15,16,17]

:(osteoperforation (MOP-Micro

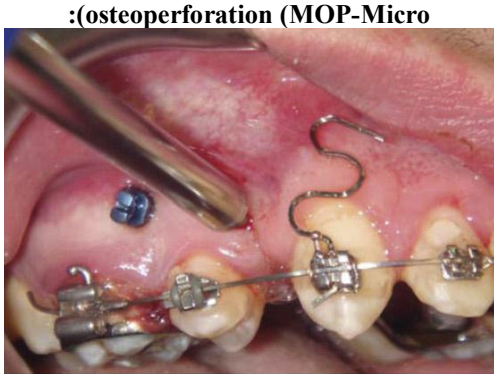

Fig4:- Micro-osteoperforation

Alikhani et al conducted a study to evaluate the effect of micro-osteoperforations on the rate of tooth movement and the expression of inflammatory markers. Three mops were performed (in the left or right side) distal to the canines and before the retraction using a disposable MOP device designed for this purpose by PROPEL Orthodontics (Ossining, NY). Mops increased the rate of canine retraction 2.3- fold compared with the control group. Mops are an effective, comfortable, and safe procedure to accelerate tooth movement during orthodontic treatment. Mops could reduce orthodontic treatment time by 62%.[19]

Cheung et al evaluated the ability of mini-implant–facilitated MOPs to accelerate orthodontic tooth movement. Mini-implants are a convenient tool that is already commonly used by orthodontists. Thus, they aimed not only to evaluate the effectiveness of MOPs in inducing accelerated tooth movement, but also to examine the use of mini-implants as an additional technique for MOP placement and investigated the potential risks for root resorption. . Mini-implant–facilitated MOPs can effectively accelerate tooth movement. These MOPs act by inducing bone remodeling, as evidenced by an increase in osteoclast quantity and a decrease in bone volume and bone density. Mini-implant–facilitated MOPs did not cause significant root resorption. Mini-implant–facilitated MOPs may become a readily available and effective treatment modality to accelerate orthodontic treatment with excellent patient acceptance.[20]

Low Level Laser Therapy (LLLT):-

Fig 5:- Low level laser therapy[24]

Recent studies done in the field of accelerated OTM have shown that low level laser therapy (LLLT) is a useful method for acceleration of tooth movement and alveolar bone remodeling as it is easy to use in a normal clinical setup, non-invasive, and do not need any special expensive inventories.

A study conducted by Cruz DR. et al (2004) showed significant higher acceleration of the retraction of canines on the side treated with LILT when compared to the control.[21]

Another study was conducted by Youssef M. et al (2008) with the aim to evaluate the effect of the low-level (GaAlAs) diode laser (809 nm, 100 mW) on the canine retraction during an orthodontic movement and to assess pain level during this treatment. The velocity of canine movement was significantly greater in the lased group than in the control group.[22]

Putting together all the clinical studies, Ga-Al-As diode laser of 780-810nm wavelength was found to accelerate velocity of orthodontic tooth movement when a continuous wave of 5-20 J/Cm^2 , 2-8J was applied by contacting the tip of the laser to the gingival surface.[23]

Vibration:-

A study was conducted by Nishimura et al to investigate the effects of stimulation by resonance vibration on the speed of tooth movement and root resorption during experimental tooth movement. They concluded that the application of resonance vibration might accelerate orthodontic tooth movement via enhanced RANKL expression in the PDL with no additional damage to periodontal tissues, as well as root resorption.[25]

Xue et al demonstrated that LIPUS (Low-Intensity Pulsed Ultrasound) promotes alveolar bone remodeling by stimulating the HGF/Runx2/BMP2 signaling pathway and RANKL expression in a rat orthodontic tooth movement model, and LIPUS increased BMP2 expression via Runx2 regulation.[26]

Platelet rich plasma (PRP):-

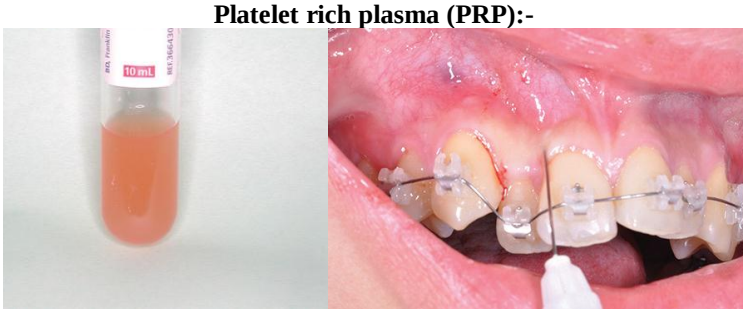

Fig.6:- Platelet rich plasma

The submucosal injection of platelet rich plasma (PRP) is a technique developed for accelerating orthodontic tooth movement by simulating the effects of bone insult without surgery and loss of alveolar bone. Liou EJ revealed clinically that submucosal injection of PRP accelerated the mandibular or maxillary alignment 1.7 folds faster in average, and the acceleration was dose-dependent when the PRP fold was <12.5. The optimal PRP fold for a more than 2-fold acceleration of orthodontic alignment ranged from 9.5 to 12.5 folds. On the other hand, the injection of PRP on the pressure side of *en masse* anterior retraction decreased 71–77% of alveolar bone loss, and this was dose-dependent. The pressure side of *en masse* anterior retraction had no alveolar bone loss when the PRP fold was higher than 11.0. The optimal PRP fold for the best performance in acceleration of orthodontic tooth movement and preservation of the pressure side alveolar bone is 11.0–12.5.[27]

Gulec et al conducted a study to determine the effects of different concentrations of platelet-rich plasma (PRP) on alveolar bone density and orthodontic tooth movement. They concluded injection of high concentration of PRP could accelerate orthodontic tooth movement by decreasing the alveolar bone density on paradental tissues by enhancing osteoclastic activity in a transient way. A moderate concentration of PRP was also effective but less so than a high concentration of PRP to increase the amount of orthodontic tooth movement.[28]

Conclusion:-

The drawbacks and uncertainties of all these techniques made them less preferred in clinical practice. However, biological approach in orthodontics interests many product companies. Study of these approaches would lead to new research and development in field of Orthodontics as an answer to today's fast paced life.

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