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Rapid maxillary expansion using bone anchored Hybrid Hyrax appliance in adolescent females.

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ABSTRACT

Background: Rapid maxillary expansion (RME) is one of the most frequently used methods in correction of deficient maxillary arch width. Posterior crossbite, whether unilateral or bilateral, are dental manifestations of an underlying skeletal transverse deficiency of the maxilla. The main scope of most expanders developed and modified to date, is to produce more skeletal (orthopedic) correction than dental (orthodontic) expansion. Orthopedic changes are easily produced and better carried out on children than on older age groups due to incomplete interdigitation of the palatal sutures. Conventional expansion appliances of the tooth-borne category depend on dental units for anchorage. This, however, adversely affect the supporting peridontium and bone of these teeth. On the other hand, tooth-tissue borne expanders category are bulky and cause gingival irritation. With the aid of the temporary skeletal anchorage devices such as (mini-screws), which are fixed to the anterior palatal bones, the huge separating forces generated during rapid maxillary expansion are conducted to the anterior palatal shelves through the anchorage devices. Thus, producing less dental drawbacks. This is thought to be of particular interest when the maxillary width reaches its adult size and the palatal suture is interdigitated as in the case of adolescent patients needing skeletal expansion of the maxillary arch. **Objective:** Our main objective was to evaluate the dento-skeletal effect of maxillary expansion using bone anchored Hybrid Hyrax expander by means of two palatal para-median mini-screws. **Results:** A significant increase of all skeletal and dental transverse variables from T1-T2 was found for the linear measurements on the study cast and on that of the PA cephalometric measurements. The expansion at the level of the 1st molar was the greatest followed by gradual decrease at the level of 2nd then 1st premolars anteriorly to the level of the canines. Correction of the crossbite was successfully achieved in all subjects.
Conclusion: The Hybrid Hyrax expander is effective in providing both skeletal and dental correction of maxillary crossbite in females of the critical age of adolescence.

INTRODUCTION

Rapid maxillary expansion (RME) was considered one of the earliest orthodontic attempts to correct skeletal transverse discrepancies and crossbites. Several types of expanders are available now whether removable, fixed, with screw or without, each with promising treatment outcomes regarding skeletal and dental transverse correction. Nevertheless, a clinician should choose the right appliance according to several patient-based factors (Agarwal and Mathur 2010).

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Patient's age, severity and the nature of the posterior crossbite, degree of cooperation, availability and integrity of anchorage units are very important factors to consider not only for appliance choice, but also in determining the expansion rate and the activation period duration needed, (Sylvia *et al*., 2015), (Proffit *et al*., 2013) and (Agarwal and Mathur, 2010). A study by (Maram *et al*., 2012) found the posterior crossbite to be prevalent in females than males with a ratio being (6:4).

RME is said to correct transverse deficiency in a short duration and with less dental side effects. This is true in mixed dentition stage where the suture is yet patent thus; the majority of the forces generated are directed to separate the palatal halves (Sylvia *et al*., 2015) and (Ramoglu *et al*., 2010).

By comparison, (Petrén *et al*., 2003), declared that at the critical age of adolescence especially in females, less skeletal alterations were expected using conventional tooth-borne expanders owing to the already interdigitated palatal suture. Consequently, most side effects of the conventional tooth-borne and tooth-tissue borne methods in older age groups were dental in origin, e.g.: buccal tipping of anchored teeth, vascular pulpal changes and active root resorption (Lione *et al*., 2013). With this considered, (Agarwal and Mathur, 2010) and (Gill *et al*., 2004) indicated that the only possible treatment was the invasive surgical procedure aiming to separate the palatal bones.

The rapid evolve of temporary bone anchorage devices (TADs) and the success achieved in application of orthopedic forces through them directly to the bone was evident in different studies, (Shett *et al*., 2011), (Lee *et al*., 2010) and (Carlson *et al*., 2016). The best location providing maximum mini-screws stability, safety and efficiency in the oral cavity was found to be the anterior palate, precisely, at the level of the third palatal ruga area, 2-3 mm paramedian to the mid palatal suture, (Hourfar *et al*., 2015, b), (Ludwig *et al*., 2011), (Hourfar *et al*., 2015 a,b), (Nienkemper *et al*., 2015) and (Miano *et al*. 2016).

Several extensive surgical procedures were eliminated and many dental drawbacks were overcome by conducting the expanding forces to the palatal shelves through the skeletal anchorage units, in order to increase the orthopedic effects. Recent TAD-assisted expander designs were proposed to combine the advantages of both the tissue-borne and tooth-borne designs and provide more orthopedic expansion and less dental tipping (Chane-Fane and Darque, 2015), (Vassar *et al*. 2016), (Hourfar *et al*. 2016) and (Yilmaz *et al*., 2016).

The combined skeletal and dental anchorage for rapid transverse expansion was found to produce orthopedic forces with less dental side effects in young patients as shown in (Wilmes *et al*. 2010) study.

This study aims to evaluate the dento-skeletal effect of the Hybrid Hyrax expander in correction of posterior crossbite in adolescent females.

MATERIAL AND METHODS

The protocol of this study was approved by the ethics committee of Mansoura University, each enrolled patient had the procedures explained, their questions answered and a written consent was signed by the patients' guardians. Thirteen female patients were initially selected from the orthodontic department out-patient clinic. Only 10 with the mean age of (14.6) met the inclusion criteria, that is:

- Constricted maxilla with unilateral or bilateral posterior cross-bite.
- Permanent dentition with no congenitally missing or extracted maxillary canines, premolars, and first molars
- Skeletal Class I range.
- Good oral hygiene

Patients with systematic diseases, abnormal oral habits, cleft lip or palate, previous orthodontic therapy prior to this treatment, inability to keep appointments after miniscrew/appliance insertion and inability to activate the appliance as instructed, were excluded from the study but otherwise treated as needed.

Participants were treated with rapid maxillary expansion utilizing a skeletally anchored Hybrid Hyrax appliance (Fig 1). The treatment was conducted by one examiner Y.H. After topical and local anesthesia administration, the palatal mucosa thickness was measured with a sharp probe. Two miniscrews (3M Unitek™ TAD, 3M Unitek™, Monrovia, California, USA) with a 1.8-mm diameter and an 8-mm length were inserted using a Unitek™ TAD Contra Angle Driver at the level of the third palatal rugae area, near right and left first premolars, 2-3 mm paramedian to the midpalatal suture (Fig 2 a and b). Molar bands were fitted to the maxillary right and left first molars. Caps (3M Unitek™ TAD O-Caps) were placed over the miniscrews, and a single step silicone base impression was taken. The laboratory analogs were inserted into the transfer O-caps after which the impression was poured, followed by the hybrid Hyrax® (Leone orthodontic products, Sesto Fiorentino, Firenze, Italy) fabrication (Fig 1). The expander was installed one week after the miniscrews insertion. O-caps were secured to the miniscrew head and the first molars bands were bonded by light cured adhesive cement (Band-it, DB orthodontics, UK).

Parents were carefully instructed on how and when to activate the appliance and were given a time table to mark on for each activation. They were instructed to activate it twice a day (a quarter turn every 12 hours). Patients were appointed every week for evaluation, all of them showed a clinically evident midpalatal suture split manifested by the appearance of a diastema between the central incisors. When the palatal cusp tips of the maxillary first molars were in contact with the corresponding buccal cusps of the mandibular first molars, expansion was rendered complete and post expansion records were obtained. In the same appointment the Hybrid Hyrax was fixed with a ligature wire, and a fixed orthodontic appliance was bonded to the upper teeth. The same appliance was left in place as a retainer for 3-4 months during leveling and alignment (Fig 3 and 4).

Each patient had their panoramic, occlusal radiograph, lateral and postero-anterior (PA) cephalometric x-rays before and just after the last turn of the expansion screw. Hand wrist radiocentegraphy was taken only before treatment for growth and maturity indication. Maxillary occlusal x-rays were used to confirm the patency of the palatal suture after expansion (Fig 5 a and b)

Lateral and PA cephalometric radiographs were performed in a standardized fashion by the same technician. All cephalometric radiographs were hand traced by the same examiner. Two months after the first tracing, 14 (7 lateral and 7 post-anterior cephalometric xrays) were randomly picked and retraced for error detection. Skeletal and dental changes of the Hybrid Hyrax appliance were evaluated through radiography and study models. (Table 1, 2, 3)

Definite points on the dental casts obtained before and immediately after expansion and were measured using a digital caliper. (Fig. 6)

Owing to the minimal dental involvement in the Hybrid Hyrax expander used in this study, a fixed appliance was fixed just after expansion and during the 3-4 months retention phase with no need of delay. It was also used as a source of indirect absolute anchorage to perform various orthodontic tooth movements as needed in each individual case.

-Data analysis and statistics:

Both Cephalometrics (lateral and postero-anterior) and dental cast data were analyzed using IBM SPSS software package version 20.0. [(2)] The distributions of quantitative variables were tested for normality. Significance of the obtained results was judged at the 5% level. Paired t-test was used for normally quantitative variables, to compare between pre and post-expansion (T1 and T2) respectively.

Results:

All included cases successfully achieved the intended expansion in 7 to 20 days. All inserted mini-screws were stable at the time of appliance insertion and remained so after the post expansion records were taken and during the retention phase of 4 months.

The values of the lateral cephalometric variables, before and immediately after expansion, table (1), showed significant increase in the means of SNA ($1.05^0 \pm 0.69$), ANB significantly increased by ($0.95^0 \pm 0.72°$); almost close to the amount of anterior displacement of the maxilla, with no apparent alteration in the sagittal position of the mandibular base; SNB: ($0.0^0 \pm 0.91$). Wilcoxon ranks test was used to obtain Wits appraisal which recorded an insignificant (0.16 ± 0.85).

The vertical behavior of the apical bases immediately after expansion showed an increase in the means of variables FMA (0.75^0), SN-MP (0.42^0), SN-PP (0.55^0) and MMPA (0.25^o). These changes, however, were statistically insignificant $p > 0.05$.

An increase in the means of variables of facial height: N-Me (1.25 mm), ANS-Me (0.98 mm), S-Go (1.15 mm) was noted. Nonetheless, this increase was statistically significant for ANS-Me and S-Go but not N-Me.

The measured dental cephalometric variables, U1-SN ($0.45^0 \pm 2.48$), L1-MP ($0.80^0 \pm 1.75$) and inter-incisal angle ($0.65^0 \pm 3.38$) increased insignificantly after expansion, $p > 0.05$.

PA cepahlometric measurements revealed significant increases both in the skeletal (nasal and maxillary) and dental (upper intermolar and upper inter-incisor) widths. Skeletal Mx-Mx (1.68 mm ± 2.07), Ln-Ln (2.19 mm ± 1.29) and dental Um-Um (3.96 mm ± 1.98), Uia-Uia (6.21 mm ± 1.70), were p value < 0.05 (Table 2).

Study models measurements revealed a significantly increased maxillary arch perimeter and depth of (3.89mm ± 1.33) and (0.78mm ± 0.78), respectively. Occlusal transverse changes pre and post-expansion were measured as shown in Table 3: The canines were erupted in 5 cases only, consequently, the inter-canine width was measured only in those 5 cases with the means of variables being (3.18mm ± 1.08) in palato-gingival mid-point (P-G mid). This point was used to measure the palatal width at the level of the canines, 1st premolars, 2nd premolars and first molars. (2.86mm ± 0.69) was registered at the inter-canine's cusp tip. The inter-first premolar means of difference at palato-gingival mid-point: (P-G mid) was (3.06mm ± 1.27), (3.41mm ± 1.25) at buccal cusp tip (BC tip) and (3.17mm ± 1.12) at palatal cusp tip (PC tip). The post-expansion increase in the inter-second premolar area was relatively higher than that at the inter-first premolar region were the means of variables at palato-gingival mid-point: (P-G mid): (3.82mm ± 1.64), buccal cusp tip (BC tip): (4.01mm ± 1.73) and at palatal cusp tip (PC tip): (3.78mm ± 1.75).

The means of difference between pre-expansion and post-expansion at the inter-molar area recorded more than 5mm increase at the following points: Palato-gingival mid-point: (P-G mid): (5.16mm ± 2.43), mesio-palatal cusp tip (M-PC tip), (5.99mm ± 2.27) and (4.70mm ± 2.91) at the mesio-buccal cusp tip (M-BC tip). The increased occlusal transverse changes were all statistically significant, p value < 0.001.

Table 1: Lateral Cephalometric findings before treatment (T1), after expansion (T2) and the mean difference of each variable before and after expansion (T2-T1).

MEASUREMENT	Pre-expansion (T1)		Post-Expansion (T2)		Difference (T2 – T1)	Paired t-test	
	mean	s.d.	mean	s.d.	mean	Test of significan t(t)	"p values"
Anteroposterior							
SNA	79.75 ± 3.34	80.0	80.80 ± 3.19	81.50	↓1.05 ± 0.69	4.846*	0.001*
SNB	76.05 ± 2.54	76.0	76.05 ± 2.69	76.50	0.0 ± 0.91	0.0	1.000
ANB	3.80 ± 1.46	3.50	4.75 ± 1.81	4.75	↓0.95 ± 0.72	4.146*	0.002*
Vertical							
FMA	29.60 ± 5.31	29.0	30.35 ± 6.06	30.50	↓0.75 ± 1.81	1.307	0.224
SN-MP	42.30 ± 5.52	40.50	42.72 ± 5.69	42.10	↓0.42 ± 1.19	1.119	0.292
SN-PP	9.60 ± 2.94	9.50	10.15 ± 2.37	10.25	↓0.55 ± 2.44	0.712	0.495
MMPA	32.70 ± 6.43	32.50	32.95 ± 6.02	32.50	↓0.25 ± 2.12	0.372	0.718
Facial height (mm)							
N-Me	105.62 ± 4.70	104.50	106.87 ± 4.86	105.50	↓1.25 ± 2.34	1.691	0.125
ANS-Me	61.71 ± 3.24	60.60	62.69 ± 3.28	62.50	↓0.98 ± 0.91	3.405*	0.008*
S-Go	63.26 ± 4.77	63.60	64.41 ± 4.49	64.85	↓1.15 ± 1.57	2.314*	0.046*
Dental							
U1-SN	100.95 ± 6.05	99.0	100.50 ± 6.10	100.50	↑0.45 ± 2.48	0.574	0.580
L1-MP	91.50 ± 5.08	92.0	92.30 ± 5.14	93.50	↓0.80 ± 1.75	1.445	0.182
Interincisal angle	124.80 ± 8.84	124.0	124.15 ± 9.07	125.75	↑0.65 ± 3.38	0.608	0.559

t: Paired t-test
*: Statistically significant at $p \leq 0.05$

Table 2: Posterior-Anterior Cephalometric findings before treatment (T1), after expansion (T2) and the mean difference of each variable before and after expansion (T2-T1).

MEASUREMENT in (millimeters, mm)	Pre-expansion (T1)		Post-Expansion (T2)		Difference (T2 – T1)	Paired t-test	
	mean	s.d.	mean	s.d.	mean	Test of significant	"p values"
Skeletal							
Mx-Mx	55.79 ± 5.36	57.25	57.47 ± 5.28	58.50	↓1.68 ± 2.07	2.565*	0.030*
Ln-Ln	26.42 ± 3.0	26.10	28.61 ± 3.11	27.85	↓2.19 ± 1.29	5.388*	<0.001*
Dental							
Um-Um	51.43 ± 3.78	51.60	55.39 ± 4.14	55.25	↓3.96 ± 1.98	6.330*	<0.001*
Uia-Uia	6.51 ± 2.67	5.75	12.72 ± 3.22	12.35	↓6.21 ± 1.70	11.583*	<0.001*

Table 3: Study Model analysis before treatment (T1), after expansion (T2) and the mean difference of each variable before and after expansion (T2-T1).

MEASUREMENT In millimeters (mm)		Pre-expansion (T1)		Post-Expansion (T2)		Difference (T2 – T1)	Paired t-test	
		mean	s.d.	mean	s.d.	mean	Test of significant	"p values"
Maxillary arch perimeter		69.40 ± 7.08	68.93	73.29 ± 6.97	73.04	↓3.89 ± 1.33	9.262*	<0.001*
Maxillary Arch width								
Inter-canine	P-G mid	23.66 ± 2.22	24.70	26.85± 2.68	26.80	↓3.18 ± 1.08	6.586*	0.003*
	Cusp tip	31.71 ± 3.82	31.38	34.57 ± 4.09	34.24	↓2.86 ± 0.69	9.222*	0.001*
Inter-1st premolar	P-G mid	23.52 ± 3.15	23.37	26.58 ± 2.56	26.34	↓3.06 ± 1.27	7.641*	<0.001*
	PC tip	26.79 ± 2.83	26.95	29.95 ± 2.50	29.53	↓3.17 ± 1.12	8.955*	<0.001*
	BC tip	36.99 ± 3.11	36.89	40.40 ± 2.41	40.26	↓3.41 ± 1.25	8.601*	<0.001*
Inter-2nd	P-G mid	27.42 –	27.48	31.24 ±	31.25	↓3.82 ± 1.64	7.352*	<0.001*

premolar		2.83		1.97				
	PC tip	41.50 ± 3.07	42.22	45.28 ± 2.29	45.40	↓3.78 ± 1.75	6.826*	<0.001*
	BC tip	31.29 ± 2.68	31.69	35.30 ± 1.88	35.58	↓4.01 ± 1.73	7.320*	<0.001*
Inter- molar	P-G mid	31.25 ± 2.93	31.16	36.40 ± 1.88	36.52	↓5.16 ± 2.43	6.702*	<0.001*
	M-PC tip	35.56 ± 2.57	35.56	41.55 – 1.92	41.53	↓5.99 ± 2.27	8.351*	<0.001*
	M-BC tip	46.65 ± 3.11	46.83	51.35 ± 3.03	51.69	↓4.70 ± 2.91	5.114*	0.001*

- Palato-gingival mid-point: (P-G mid), Palatal Cusp tip (PC tip), Buccal Cusp tip (BC tip) Mesio-palatal cusp tip (M-PC tip), Mesio-buccal cusp tip (M-BC tip).

Disscussion:

Various appliances were designed to expand the upper arch. Maxillary arch expanders, whether fixed or removable, were divided according to means of anchorage: conventional, tooth-borne and tooth-tissue-borne expanders. (Agarwal and Mathur 2010) New categories were added after the introduction of TADs: Tooth-bone-borne and bone-borne expanders. Mini-screw anchored RPE directs expansion forces toward the mid-palatal suture and away from the molars, resulting in more notable orthopedic correction and minimal tooth movement.(Carlson *et al*. 2016)

Placement of TADs in the area indicated in this study proved high success and stability as was with (Hourfar *et al*., 2015 a,b) and (Nienkemper *et al*., 2015) and required no change between patients because this area has a stable vertical bone depth between the ages of 10 – 19,(King *et al*. 2006).

In the present study the tooth-bone-borne (hybrid hyrax) expander produced a significant advancement of the sagittal position of the maxilla; SNA: 1.03^{0}. This agreed with the findings of mini-screw assisted expander group both in (Hourfar *et al*., 2016) and (Yilmaz *et al*., 2015) studies and was not seen in the conventional RME groups in the same studies. Upon their findings, they concluded that the hybrid (mixed-anchorage) expanders were preferable in the treatment of skeletal Class III in young patients, due to the pronounced skeletal effect on the sagittal position of the maxilla. No significant sagittal movement of the mandibular base was recorded, so the increase of ANB angle was speculated to be a result of the anterior movement of the maxilla.

The increase noticed in the vertical skeletal changes of the jaws as well as the dental angulations were comparable to those of (Carlson *et al*., 2016), (De Rossi *et al*., 2010) and (Gungor *et al*., 2012) findings and were rendered as insignificant. Likewise, (Farronto *et al*., 2011), found that SN-MP insignificantly increased, explaining the insignificant increase of N-Me. Although, in contrast to our study, (Arman-Özçirpici *et al*., 2014) results showed significant increase in SN-MP and FMA, the negligible increase in SN-PP, and L1-MP recorded by them were comparable to our results. On the other hand, (Hourfar *et al*., 2016) found that the maxilla moved caudaly and the vertical parameters increased significantly in class I cases treated with the hybrid appliance. Our findings coincided with that of (Ramoglu *et al*. 2010) and (Gungor *et al*., 2012) which recorded a significant increase in ANS-Me as in this study. Based on our results, the little increase of the vertical facial angles were not significant, because both the lower anterior facial height ANS-Me and posterior facial height S-Go increased significantly with minute difference, thus the angles remained almost stable.

All these findings and controversies were answered by a number of studies which found this increase to be probably due to lateral rotation of the maxillary halves, decrease in palatal deepness and extrusion of molars as observed by (Singaraju *et al*., 2015), (Kumar *et al* 2011), (Garib *et al*. 2007), (Byloff and Mossaz 2004) and (Chung and Font, 2004). Above all, long-term studies as those of (Lione *et al*., 2013) and (Ballanti *et al*. 2009) found most of the vertical changes induced by RME to be transient.

Measurements obtained from the study models revealed significant increase in the maxillary arch perimeter and width at the level of the canines, 1st and 2nd premolars and 1st molars. Nevertheless, it was noted that the increase was not equal but showed a decrease from the first molar to the canines anteriorly. These findings were in correspondence with the temporary skeletal anchorage device-supported RME (TSADRME), utilized by (Vassar *et al*., 2016).

In regard to the nasal and maxillary skeletal widths measurements of PA cepahlometric evaluation, a number of cephalometric and computed tomography studies (Yilmaz *et al*., 2015), (Arman-Ozcirpici *et al*., 2014), (Ribeiro *et al*., 2012), (Christie *et al*., 2010), (Ribeiro *et al*. 2010), (Kartalian *et al*., 2010), (Lee at al., 2010) and (Garrett at al. 2008) agreed with our findings but to different extent as related to the amount of crossbite corrected. The significant increase was also seen dentally, the palatal split was assessed by measuring the transverse width between the apices of the two central incisors and that between the buccal surfaces of the first molars. (Perillo *et al*., 2014) results collaborated with both our skeletal and dental results in their study. Using conventional Hass expander, (Baccetti *et al*., 2001) had similar skeletal and dental findings in their younger group but not the older adolescent group. When compared to the findings the present study, this probably point to the orthopedic effect of the hybrid hyrax expander when used on adolescent subjects.

We suggest that a future study should be conducted utilizing the Hybrid Hyrax on a larger number of subjects with older skeletal age, based on their gender and skeletal base classification with a control group. Also a long term evaluation study would be valuable to assess the stability of the here given results.

Conclusion:

- In conclusion, several points are drawn from this study. The Hybrid Hyrax appliance corrected both unilateral and bilateral posterior crossbite manifested in all the participating subjects.
- The rapid rate of maxillary expansion using the utilized expander in this study, evidently reduced the treatment time needed for transverse correction of the maxilla with less pain or discomfort.
- Owing to the rigidity of the Hybrid Hyrax appliance, and the anteriorly placed skeletal anchorage, almost an immediate skeletal response of sutural separation was clinically evident in most cases. The appearance of a midline diastema was seen in all cases during the first 10 days of appliance activation.
- Clinical-wise, mini-screw insertion in the palate was simple, safe and caused almost no discomfort to the patients; all miniscrews were asymptomatic and remained stable throughout the active treatment and retention period.
- As a whole, the simplicity of the appliance design, where it was attached only to the first molars through bands, allowed continuation of orthodontic treatment during the 3-4 months of retention phase. Here, the appliance was locked and left in place eliminating the need for fabrication of an additional appliance for retention during leveling and alignment.
- From the cephalometric alterations obtained between the before and after expansion treatment time, favorable findings were noted on both the skeletal and the dental level. The significant transverse increase was measured between the apices of the two central incisors and registered a 6.21 mm increase, which indicated the amount of the suture opening.
- Although the maxillary base moved forward significantly, this was of little clinical consequences.
- .Also, clinically irrelevant dental antero-posterior angulation changes were noted.
- The amount of dental expansion registered on the study model was 2.86 mm at the level of the canine cusp tips; it then increased gradually where it reached the highest increase at the level of the mesio-palatal cusps of the first molars, 5.99 mm.
- The maxillary width increased in an ascending fashion from the inter-canine region through the inter-first premolars and inter- second premolars to the inter-molar region as measured on the study models.
- A significant increase of 3.89 mm of the maxillary arch perimeter, revealed the ability to solve crowding, thus eliminating the need of extraction in some cases.
- The skeletal effect of the expander through bone anchorage replaced the need for surgery to separate inter-digitated sutures, which makes it of a very reasonable cost.
- The RME utilizing Hybrid Hyrax expander appliance is successfully efficient in providing both skeletal and dental correction of the maxillary transverse deficiency in females of the critical age of adolescence.

Contribution of Knowledge:

The appliance detailed in this study helped in simplifying the treatment plane indicated for the treated cases, where a surgical intervention was rendered necessary in expanding the constricted upper arch. Due to various social, financial and religious beliefs, surgery is not welcomed as a treatment option to most patients/ patient's guardians. Providing a clinically effective and safe alternative with satisfactory results at a rather reasonable cost is a highly valuable addition to the well-being of the orthodontic patients and oral health care as general.

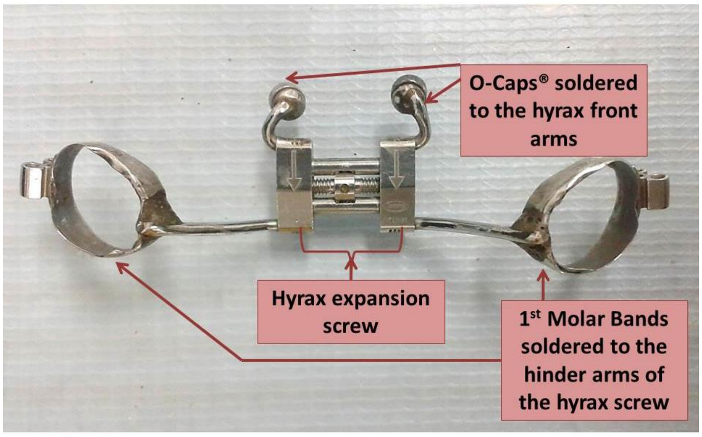

Fig. 1: The Hybrid Hyrax Expander.

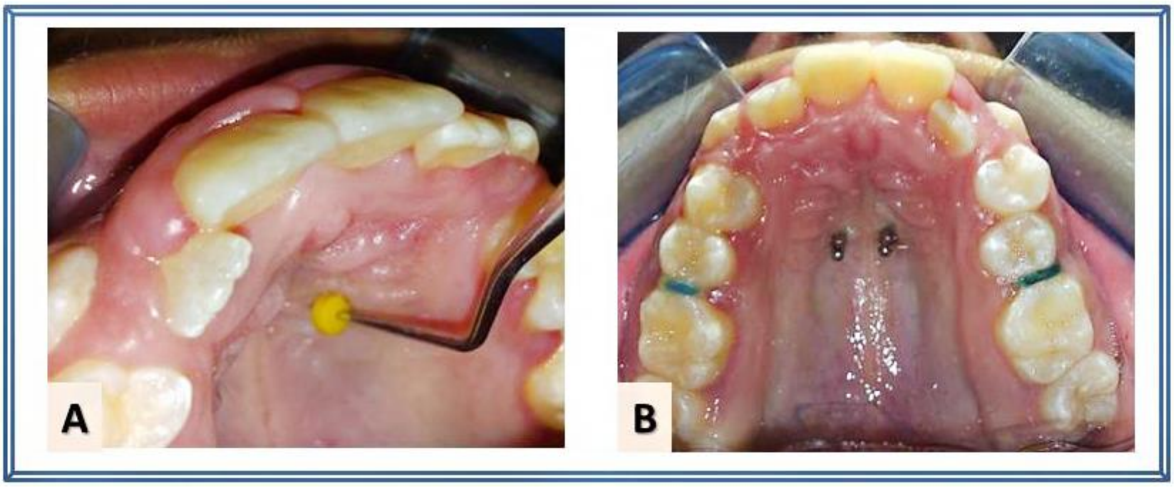

Fig. 2: (A) palatal mucosa thickness measured with a sharp probe. (B) miniscrew insertion site at the level of the third palatal rugae area,2-3 mm paramedian to the midpalatal suture.

Fig. 3: Case presented before expansion.

Fig. 4: Same case after 8 days into expansion using Hybrid Hyrax appliance.

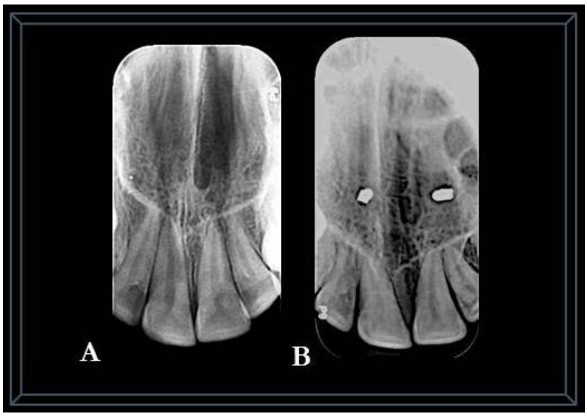

Fig. 5: (A) Occlusal x-ray before treatment **(B)** After expansion.

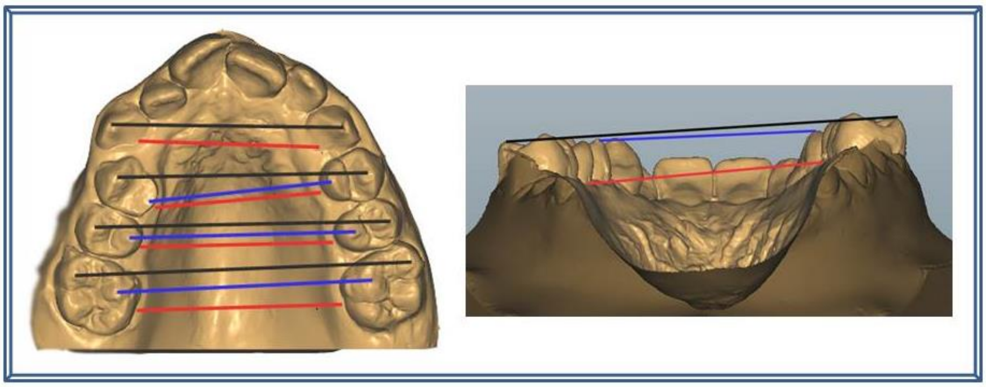

Fig. 6: RED LINES: Palato-gingival mid-point: (P-G mid), BLUE LINES: Palatal Cusp tip (PC tip), Mesio-palatal cusp tip (M-PC tip) and BLACK LINES: Buccal Cusp tip (BC tip), Mesio-buccal cusp tip (M-BC tip)

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