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Original Research Article

Mandibular posterior bone anchorage technique using steel wire: a retrospective descriptive study on dental movements and clinical tolerance

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Abstract – Introduction: In 2015, a new technique for posterior mandibular bone anchorage, termed "Abalakov", was introduced. This technique enables the distalization of mandibular teeth and the entire arch as needed, utilizing a single steel wire anchored to the internal oblique line of the mandibular ramus. This study aims to describe the dental movements achieved with Abalakov anchorage for targeted orthodontic adjustments. Secondarily, it profiles the patients who underwent this technique and evaluates their clinical responses, particularly regarding any signs of intolerance. **Method:** We conducted a retrospective descriptive study of patients treated by specialists in orthodontics and maxillofacial surgery in Lyon, France, from 2015 to 2023. A total of 32 cases involving 59 Abalakovs were analysed, gathering data on orthodontic treatment details, patient demographics, and post-operative effects. **Results:** The average molar retreat measured 3.70 mm (σ: 2.78 mm), and incisal straightening averaged 10.80° (σ: 8.13°). The rates of inflammation, infection, and loss of anchorage were 5.1%, 1.7%, and 13.6%, respectively, with class II decompensation was the primary indication with 84%. **Conclusion:** The Abalakov method appears to complement the therapeutic arsenal available to orthodontists and surgeons for the treatment of patients requiring solid mandibular posterior anchorage.

Introduction

The movement of the molar or mandibular arch backwards is complex to manage, and the applied forces to achieve it must be significant and controlled [1].

Numerous anchorage techniques are used to achieve this movement, in particular mini-screws and mini-plates. Mini-screws have the advantage of being easy to use, but their stability is poor and the screw is often lost. Mini-plates are more stable over time, but require surgical dexterity for shaping the plate and may have poor clinical tolerance [2–4].

The system of posterior mandibular anchorage, named "Abalakov", using osteosynthesis wires, optimises the advantages and reduces disadvantages of the 2 previous techniques [5–9].

In fact, in a single surgical step and using a single steel wire inserted into the ascending ramus of the mandible, the orthodontist can perform the movement of the arch backwards and the lingo-version of the mandibular incisors.

The results found for incisor redress and molar pullback seemed conclusive in previous studies [6–10].

The aim of this retrospective descriptive study was to describe the dental movements obtained with the Abalakov anchorage in the context of targeted orthodontic movements. Secondarily, it aimed to carry out a description of the population that had been subjected to this technic, and the nature of the clinical response of patients and the manifestation of any form of intolerance.

Method

To achieve the objectives, we performed a retrospective descriptive study on patients who had received orthodontic treatment involving the use of an Abalakov anchorage system.

We conducted the study on patients treated by a single operator, (orthodontic specialist, private practice, Lyon, France) and by 4 specialists in maxilla-facial surgery (Maxillo-facial surgeons, private practice, Lyon, France) over a period from 2015 to 2023.

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Fig. 1. Photograph of a model with 2 Abalakov anchors, right and left, side and occlusal view.

This study received ethical approval from the Ethics committee of Hospices Civils de Lyon under the protocol number 24-5062. The inclusion criteria were to have received one or more Abalakov anchorage systems during orthodontic treatment.

We collected 32 cases for a total of 59 Abalakovs.

All patients were treated orthodontically with the same archwire sequence for vestibular and lingual brackets, with the addition of vestibular brackets to maintain the spring in the lingual technique. The spring used for distalization was a NiTi 300 grams-force spring in all cases (Fig. 1). The surgical procedure was the same for all patients and the wire used was identical, *i.e.*, a soft 0.4 mm diameter steel wire (osteosynthesis wire) positioned on the internal oblique line of the mandible (Fig. 2).

The Abalakov anchor was removed by simply cutting and pulling the osteosynthesis wire, and a contact anaesthetic or local anaesthetic could be used. Profile teleradiography was not systematically carried out at the end of anchorage use, when a clinical check or panoramic radiograph was sufficient (particularly in cases of class 3 compensation).

The data obtained was processed and analysed in a spreadsheet using Excel ® software, in the form of means (with standard deviations) and percentages.

To analyse dental movements, cephalometric tracings were made on profile teleradiographs before and after treatment using Cephio ® and BlueskyBio ® software, by the orthodontic specialist.

The cephalometric analysis included:

- IMPA angle (angle between the mandibular plane and the long axis of the mandibular incisor) to quantify the straightening of the incisor axis,
- Frankfort plane line (connecting the Porion point to the Orbital point),
- Perpendicular line (VHF) to the Frankfort plane passing through the pterygoid point (Pt).

These lines were the reproducible horizontal and vertical references used to quantify molar backoff, with:

- C: the most distal point of the crown of the mandibular first molar.
- Distance C — VHF: measurement of the distance between C and the vertical reference line: measurement was used to quantify molar backoff at the coronal level of the mandibular first molar.

The data was described in the form of averages and percentages for the criteria used to describe the population concerned, the clinical consequences of the technique and the main dental movements.

The criteria analysed were:

- Dental movements obtained: straightening of the incisal axis, molar displacement with measurement of the crown back-off at the mandibular first molar.
- Post-operative effects: inflammation or infection of the anchorage area, which might have required removal; loss or breakage of the anchorage; sensitivity problems in the sensory territory of the lingual nerve,
- Simultaneous avulsion of the mandibular wisdom teeth when the device is fitted,
- The anchorage indication(s): class II decompensation prior to orthognathic surgery, mandibular arch asymmetry treatment, space opening, dental class III compensation with or without associated orthognathic surgery,
- The time of use, *i.e.*, the amount of traction that was applied to the arch wire by an active spring
- Simultaneous use of the mandibular incisor reduction technique (stripping),
- The position of the orthodontic arch: vestibular, lingual, or mixed (vestibular in the mandible and lingual in the maxilla),
- Oral hygiene by the number of times the teeth were brushed per day,
- Smoking status,
- Gender (female/male),
- Age on the day the anchoring device was fitted.

Fig. 2. QRCode to access a surgical modelling video.

Results

Dental movements

Of the 32 cases analysed, 3 did not have a post-treatment profile teleradiograph, as there was no need for this radiograph at the end of treatment. The analysis of dental movements therefore included 29 cases.

Molar back-off (most distal point of the crown of the mandibular first molar) averaged 3.70 mm (σ: 2.78 mm) (Tab. I).

Incisal straightening averaged 10.80° (σ: 8.13°) (Tab. I).

Population

Of the 32 cases analysed, 72% were women, and the mean age on the day the anchorage system was fitted was 32 yr (Tab. II).

The average number of times the teeth were brushed per day was 2, and none of the patients were smokers.

Technique

All patients benefited orthognathic surgery if this was indicated. All patients completed their treatment with a Class 1 dental occlusion.

The anchorage system was used for an average of 6 months (σ: 1.4 months). No mandibular incisor stripping was performed.

Most patients received vestibular arch treatment (62.5%) in the maxilla and mandible, 34.4% had a mixed appliance, *i.e.*, a palatal arch in the maxilla and a vestibular arch in the mandible, so 97% had vestibular arch for the lower jaw. 1 patient wore a palatal and lingual arch (Tab. II).

Most patients had their wisdom teeth removed at the start of treatment and 10 patients had their 3rd lower molars removed on the day the anchorage system was placed (Tab. II).

None of the patients had sensitivity problems in the sensory territory of the lingual nerve and all the Abalakovs were placed on the internal oblique line.

The main indication was class II decompensation, accounted for 84% of indications, followed by arch asymmetry treatment (22%), class III dental compensation (16%) and, finally, space opening (6%) (Fig. 3).

Of the 59 Abalakovs, 3 presented localised inflammation of the mucosa or gingiva around the anchorage system, with a favourable outcome after repositioning the anchorage wire and/or spring and implementation of strict oral hygiene measures with the introduction of chlorhexidine mouthwashes for 7 days. No system required removal for management of localised inflammation. The left side showed more inflammation than the right side. Only 1 right sided anchorage presented a local infection. It was treated with simple 7 days antibiotic therapy and strict oral hygiene measures with the introduction of chlorhexidine mouthwashes for 7 days. The anchorage system did not need to be removed. Eight anchorages were lost or broken, with only one that needed to be replaced. The other cases of loss or breakage occurred at the end of the treatment. More Abalakovs were lost or broken on the left side than on the right (Tab. III).

Discussion

The overall results obtained were satisfactory. Dental movements appeared to be in line with the results obtained by Loris Wagner, *i.e.*, an average molar pullback of 2.8 mm at 6 months and an average incisal straightening of 13.8° [10]. The incisal straightening which appeared to be less good in our study (10.80° (σ: 8.13°)) is due to the difference of inclusion indications from one study to another. Our inclusion criteria were not only decompensations of class II but also asymmetries or openings of spaces and in particular dental class III for which the mandibular incisors may already have a correct axis or even a lingo version that we will want to correct. Therefore, this will lead to a decrease in the average straightening of the incisor axis. The average molar pullback was 2.8 mm [10], which also seems to be in line with our result of 3.70 mm.

The treatment objectives varied depending on the indications and the clinical case, but we have been able to carry out each treatment successfully and therefore consider the Abalakov anchorage technique to be acceptable for achieving the desired tooth movements.

Table I. Description of the dental movements (29 cases).

			Averaged	SD
Molar back-off			3,70 mm	σ: 2.78 mm
	Minimum	0,2 mm		
	Maximum	12,1 mm		
Incisal straightening			10,80°	σ: 8.13°
	Minimum	0,2°		
	Maximum	21,8°		

Table II. Description of the population: sex, average age on the day of anchorage, positioning of the orthodontic arch, avulsion of wisdom teeth during the same operation.

	n	Percent	Average
Male	9	28%	
Female	23	72%	
Age on the day of installation			32 yr
Arch position			
Vestibular	20	62,5%	
Mixed	11	34,4%	
→ Vestibular for the mandible	31	96,8%	
Lingual	1	3,13%	
Avulsion of wisdom teeth during the same operation			
Yes	10	31,2%	
No	22	68,7%	
Total	**32**		

n : number of patients.

In comparison with other anchoring techniques, in particular mini-plates and mini-screws, the results appeared to be comparable and need to be confirmed by an appropriate comparative study.

The stability of the mini-plate when placed on the mandibular body is around 85% according to Takaki *et al.* [11], falling to 78.31% for mini-screws placed in the mandible [12], Wu *et al.* also found instability of screws in the mandible with a failure rate of 16.3% [13] and Azeem *et al.* had a failure rate in the retro-molar area of 23.2% [14]. We seemed to find a better stability rate with Abalakov anchorage than with mini-plates or mini-screws, with a 13.6% rate of loss or breaking of the anchorage. Of their 10 cases, Chastanet *et al.* [6] had no loss of anchorage by Abalakov or early removal and were able to use all their anchorage systems.

In comparison with a similar technique, Melsen *et al.*, on their zygomatic ligatures, found 5 anchorage losses in 30 patients treated over 15 yr [3].

Of our 8 Abalakovs lost prematurely, 3 were inserted at the same time as the wisdom teeth were avulsed. The link with the fragility of the bone after the alveolectomy needs to be clarified with a study to establish a causal link.

The anchor, which developed a local infection that resolved with antibiotic therapy, had not been placed at the same time as the avulsion of the wisdom teeth.

Takaki *et al.* [11] also note that inflammation is a factor in the instability and failure of mini-plate anchorage, as it is for mini-screws. The rate of inflammation in Abalakovs was approximately 5.1%, with no possibility of proving a causal link with anchor instability.

Inflammation was greater on the left (7%) than on the right (3%), which could be linked to greater difficulty for the surgeon in correctly placing the anchor in sector 3 and therefore difficulty for the patient in controlling the plaque. Azeem *et al.* explain that the right side shows more instability of the mini-screws than the left side, linked to a lack of control of the plate (more inflammation on the right), probably due to the fact that the majority of patients are right-handed. In our study, there was more inflammation on the left side, which does not seem to be related to the patient's difficulty with conventional brushing, but perhaps to inadequate placement of the anchor [14].

Treatment times are around 20 months for mini-plates according to the studies [1,15] and vary between 6 and 12 months for mini-screws [11–14,16–26]. Treatment time is

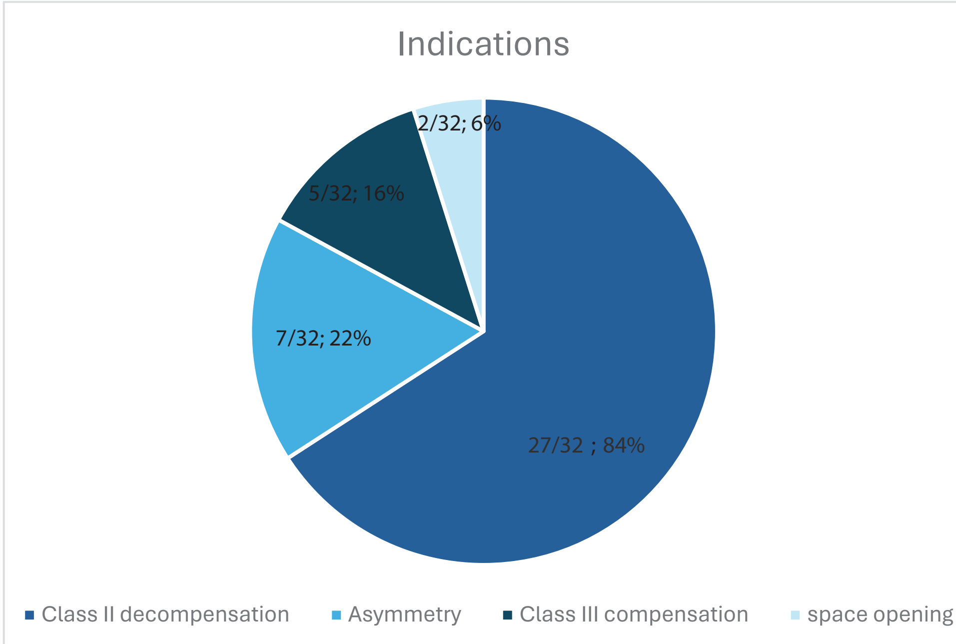

Fig. 3. Graph showing the distribution of indications of use of the anch.

Table III. Description of clinical tolerance (inflammation, infection, loss of anchorage) in number of anchorages and percentage.

	Inflammation	Infection	Loss of anchorage
Right	1/30 (3%)	1/30 (3%)	3/30 (10%)
Left	2/29 (7%)	0/29 (0%)	5/29 (17%)
Total	**3/59 (5,1%)**	**1/59 (1,7%)**	**8/59 (13,6%)**

reduced to 6 months on average with Abalakovs in our study. Coronal molar back off using mini-plates varies between 2.10 mm and 3.6 mm [25,27], while mini-screws achieve molar recession of between 1.6 and 3.4 mm depending on the study [11–14,16–26], the result seems fitting and comparable, with an average molar recoil of 3.70 mm (σ: 2.78 mm).

Incisal straightening with mini-plates in Yeon *et al.* was 9.2° [25] and 4.8° with mini-screws; our result of 10.80° (σ: 8.13°) seems comparable to the mini-plates technique.

The theoretical ideal incisal angle is about 90° (according to Tweed), but clinically it will be necessary to adapt it according to the clinical case while respecting the harmony and the global aesthetics of the face. In case of orthognathic surgery, it allows an optimal pre-surgical orthodontic preparation which is necessary to obtain at the end of the treatment a class I occlusion. It should be noted that most patients have a correct inclination of the mandibular incisors, and that the technique can be used to achieve this disposition [28].

The standard deviations (σ) of the averages for dental movements (molar distalization, incisal straightening) were very wide. This shows that, depending on the patient, the technique can be used to achieve more or less significant movements. On the other hand, the standard deviation of treatment time is narrow, at 1.44 months, reflecting the fact that on average, the anchorage is used for 6 months. For movements of greater amplitude, the traction springs need to be changed more often. The anchor therefore seems to allow movements of small or large amplitude, depending on the needs of the treatment plan, over a period of around 6 months.

In addition, we have a few criticisms to make about our study. Firstly, data collection carried out retrospectively using clinical records may result in a loss of information. Cephalometric measurements may involve errors in identifying landmarks (2-dimensional projections, superimpositions).

Further studies are needed to increase the level of evidence for the technique, by carrying out larger-scale and/or prospective studies, and to enable causal links to be understood. They could also gather further clinical and anatomical information and explore secondary movements such as mandibular rotation, incisor or molar extrusion, molar intrusion, and distal molar tilt. This would allow us to compare the dental and mandibular movements produced depending on the location of the anchorage on the ascending ramus, and to assess the ideal location for the desired movements. It would also be interesting to carry out a study with an appropriate design for comparison with other distalization techniques (mini-screws and mini-plates).

Conclusion

The Abalakov anchorage technique appears to offer similar or even potentially superior results to the methods using mini-screws or mini-plates in terms of distalizing the mandibular arch and straightening the mandibular incisors.

Mandibular posterior wire anchorage is characterised by its ease of insertion and surgical removal. It takes up little space for the patient, is easy for the orthodontist to use and is inexpensive.

This technique appears to be clinically well tolerated locally, with a low rate of inflammation, loss, or breakage and nearly no local infection.

It is conceivable that this method will complete the therapeutic arsenal available to orthodontists and surgeons for the treatment of their patients requiring a solid mandibular posterior anchorage. The adoption of this technique will need to be based on an understanding of the advantages and disadvantages associated with it, to meet the specific needs of each patient.

The resulting conclusions from this investigation can inform practitioners specialising in orthodontics and surgery. These findings, by providing new insights into the performance and clinical implications of the device, can be used to guide decisions in the choice of the most appropriate therapeutic techniques

More work needs to be done to increase the level of evidence for this technique, to shed light on points that have not been addressed and to compare techniques through appropriately designed studies.

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Conflicts of interest

All authors state that they have no conflicts of interest.

Data availability statement

All data analyzed during this study are included in this published article. Additional datasets used during the current study are available from the corresponding author upon request.

Author contribution statement

L. Grzelczyk: Investigation, Data collection, Methodology, Writing original draft; R. Filippi, P. Cresseaux: Data collection; A. Carlier, R. Ligerot : Supervision, Validation.

Ethics approval

This study received ethical approval from the Ethics committee of Hospices Civils de Lyon under the protocol number 24-5062.

References

1. Sugawara J, Daimaruya T, Umemori M, Nagasaka H, Takahashi I, Kawamura H, *et al.* Distal movement of mandibular molars in adult patients with the skeletal anchorage system. Am J Orthod Dentofacial Orthop 2004;125:130–138.
2. Melsen B, Verna C. Anchorage problems. In: Melsen B, Ed. Adult Orthod., West Sussex, UK: John Wiley & Sons, Ltd. 2013, p. 132–62.
3. Melsen B, Godtfredsen Laursen M. Have TADs changed the role of the orthodontist in the rehabilitation of the degenerated dentition? J Dent Craniofacial Res 2017;02:1–13.
4. Bassigny F, Chillès D, Chillès J-G., Dumoulin B, Filippi R, Le Gall M, *et al.* Nouvelles conceptions de l'ancrage en orthodontie. CdP, Vol. 1, 2013.
5. Depeyre A, Carlier A, Filippi R, Cresseaux P. Abalakov technique for global mandibular distalisation: technical note. Br J Oral Maxillofac Surg 2022;60:209–210.
6. Chastanet S, Louisy A, Bonnin F, Kulker D, Laure B. Abalakov: Posterior mandibular anchorage technique for orthodontic treatment. J Stomatol Oral Maxillofac Surg 2020;121:575–578.
7. Bernard-Granger C, Cresseaux P, Filippi R. Enfin du nouveau dans l'ancrage mandibulaire postérieur. Rev Orthopédie Dento-Faciale 2018;52:65–80.
8. Pernier C, Cresseaux P. Presurgical orthodontic preparation of skeletal Class II by means of a bone anchorage with an osteosynthesis wire: a clinical case. Orthod Fr 2021;92:17–28.
9. Cresseaux P, Filippi R. Quand l'alpinisme vient révolutionner l'ancrage orthodontique. ID 2017;6:40–47.
10. Wagner L. Recul mandibulaire en masse par fils d'ostéosynthèse: une étude de cohorte. UNIVERSITÉ CLAUDE BERNARD-LYON I.U F. F.R. D'ODONTOLOGIE, 2019.
11. Takaki T, Tamura N, Yamamoto M, Takano N, Shibahara T, Yasumura T, *et al.* Clinical study of temporary anchorage devices for orthodontic treatment. Bull Tokyo Dent Coll 2010;51:151–163.
12. Jing Z, Wu Y, Jiang W, Zhao L, Jing D, Zhang N, *et al.* Factors affecting the clinical success rate of miniscrew implants for orthodontic treatment. Int J Oral Maxillofac Implants 2016;31:835–841.
13. Wu T-Y, Kuang S-H, Wu C-H. Factors associated with the stability of mini-implants for orthodontic anchorage: a study of 414 samples in Taiwan. J Oral Maxillofac Surg Off J Am Assoc Oral Maxillofac Surg 2009;67:1595–1599.
14. Azeem M, Saleem MM, Liaquat A, Ul Haq A, Ul Hamid W, Masood M. Failure rates of mini-implants inserted in the retromolar area. Int Orthod 2019;17: 53–59.
15. De Clerck EEB, Swennen GRJ. Success rate of miniplate anchorage for bone anchored maxillary protraction. Angle Orthod 2011;81: 1010–1013.
16. Oh Y-H, Park H-S, Kwon T-G. Treatment effects of microimplant-aided sliding mechanics on distal retraction of posterior teeth. Am J Orthod Dentofacial Orthop 2011;139:470–481.
17. Ye C, Zhihe Z, Zhao Q, Ye J. Treatment effects of distal movement of lower arch with miniscrews in the retromolar area compared with miniscrews in the posterior area of the maxillary. J Craniofac Surg 2013;24:1974.

18. Aly SA, Alyan D, Fayed MS, Alhammadi MS, Mostafa YA. Success rates and factors associated with failure of temporary anchorage devices: a prospective clinical trial. J Investig Clin Dent 2018;9:e12331.
19. Alharbi F, Almuzian M, Bearn D. Miniscrews failure rate in orthodontics: systematic review and meta-analysis. Eur J Orthod 2018;40:519–530.
20. Rodriguez JC, Suarez F, Chan H-L, Padial-Molina M, Wang H-L. Implants for orthodontic anchorage: success rates and reasons of failures. Implant Dent 2014;23:155–161.
21. Park H-S, Lee S-K, Kwon O-W. Group distal movement of teeth using microscrew implant anchorage. Angle Orthod 2005;75:602–609.
22. Papageorgiou SN, Zogakis IP, Papadopoulos MA. Failure rates and associated risk factors of orthodontic miniscrew implants: a meta-analysis. Am J Orthod Dentofacial Orthop 2012;142:577–595.e7.
23. Kim J-W, Lee N-K, Sim H-Y, Yun P-Y, Lee J-H. Failure of orthodontic mini-implants by patient age, sex, and arch; number of primary insertions; and frequency of reinsertions after failure: an analysis of the implant failure rate and patient failure rate. Int J Periodontics Restorative Dent 2016;36:559–565.
24. Gurdan Z, Szalma J. Evaluation of the success and complication rates of self-drilling orthodontic mini-implants. Niger J Clin Pract 2018;21:546–552.
25. Yeon BM, Lee N-K, Park JH, Kim JM, Kim S-H, Kook Y-A. Comparison of treatment effects after total mandibular arch distalization with miniscrews vs ramal plates in patients with Class III malocclusion. Am J Orthod Dentofac Orthop Off Publ Am Assoc Orthod Its Const Soc Am Board Orthod 2022;161:529–536.
26. Kim YB, Bayome M, Park JH, Lim HJ, Mo S-S, Lee NK, *et al.* Displacement of mandibular dentition during total arch distalization according to locations and types of TSADs: 3D Finite element analysis. Orthod Craniofac Res 2019;22: 46–52.
27. Yu J, Park JH, Bayome M, Kim S, Kook Y-A, Kim Y, *et al.* Treatment effects of mandibular total arch distalization using a ramal plate. Korean J Orthod 2016;46:212–219.
28. Dumitrache M, Gabison K, Atrtchine A, Chabre C. Trois analyses céphalométriques usuelles. Elsevier Masson, 2013.

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