LONG-TERM EFFECTIVENESS OF CONSERVATIVE THERAPY IN PATIENTS WITH ANTERIOR DISC DISPLACEMENT WITHOUT REDUCTION

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SUMMARY
Aims. The purpose of this study is to evaluate the effectiveness of treatment with pivot appliance, adapted according to an original method, in chronic disc displacement without reduction (ADDwor).
Patients and methods. 100 patients randomly selected with Magnetic Resonance Imaging (MRI) with anterior disc displacement without reduction were examined for symptoms and signs of temporomandibular disorder (TMD) according to the Research Diagnostic Criteria and exclusively treated with a pivot appliance. The patients had been suffering from temporomandibular disorders pain, registered on a numeric pain intensity scale (NPIS) and the subjective effects of the therapy registered on a verbal scale (1= ineffectual; 2=effective; 3= very effective). It was also recorded the presence of a reduction in mouth opening and lateral movement without dental contact. Treatment outcomes were evaluated at 6 weeks and their maintenance at 2-years. The research was approved by our local institutional review board.
Results. At 6 week follow-up 94 patients had benefited from treatment with a reduction in the pain score of 87.5% and of these 68 (72%) achieved a pain reduction to zero while 23 (24.4%) reported a value of a pain as one, 2 patients (2.12%) two and one of the three. At 2 years follow-up 93 (98,9%) patients declare zero pain while 1 (1.06%) patient remained a value of two, then in 2 years pain reduced in 93.5% of the responding patients. In 6 patients who have not responded to treatment, at 6 weeks, the pain was reduced by 16.2% which was considered insufficient because these patients had pain at the beginning of treatment of 2.2 higher than the average of the other (7.6 compared with 5.4 in NPIS) and so were sent to the surgeon for arthrocentesis or arthroscopy. The average mouth opening at the beginning of treatment was 37.2 mm, at 6-week follow-up was 42.3 mm, an increase of 13.7% in 95 patients because a non-responders improved only in openness but not in pain. At 2 years follow-up, the opening has reached 43.5 mm improving by 16.9%. According to verbal scales, 90% of all patients have judge the therapy very effective, in particular, 4% effective and 6% not effective.
Conclusion. The pivot appliance has demonstrated a good efficiency in pain controlling and improving the reduction of mouth opening in both, short term and long term. The pivot appliance can, therefore, be recommended as a conservative therapy of ADDwor.

Key words: anterior disc displacement without reduction, temporomandibular disorders, pain, pivot appliance, distractive effect.

Introduction

With chronic disk dislocation without reduction (ADDwor), we mean a disc dislocation from its physiological position without being able to re-establish a normal relationship disk-condyle during any mandibular movement. In any case, you can not restore tissue integrity or normal relations between the particular components, therefore, therapy is only symptomatic. Many conservative treatment options have been proposed: counseling to inform and reassure the patient, Michigan splint type or plans in the event of a suspected muscle hyperactivity combined with relaxation exercises, pharmacotherapy in case of pain and manual therapy (1-5).
The pivot appliance was designed to cause a distracting effect on the articulation, so as to redistribute the loads on the articular surfaces.

The objective of this study is to test the effectiveness of a pivot appliance in pain control in patients with ADDwor. The hypothesis is that, if this type of splint is adapted according to the method described here, will be clinically effective in a very short time, lower than that considered necessary for a spontaneous improvement in a part of these patients (6-8).

Patients and methods

The inclusion criteria of the study were:

- Pain of articular origin in patients with symptoms and signs of ADDwor, with or without limited opening, according to the Research Diagnostic Criteria for TMD of Dworkin and LeResche (9)
- Self-assessed worst articular pain of at least 2 on a graded numeric pain intensity scale from 0 to 10
- Duration of pain below of 4 months

Exclusion criteria were:

- Pain from muscular origin
- Systematic joint disease diagnosed (rheumatoid arthritis, ankylosing spondylitis, arthritis psoriasis)
- TMJ Previous surgery treatment.

The average age of the group was 36.9 years, including 8 males and 92 females. The research was approved by our local institutional review board. Twenty patients had bilateral ADDwor, but the only one complained pain from both sides and only, in this case, was performed distraction bilaterally. The remaining cases involved 45 TMJ in the left side and 35 in the right side. For data collection was used a self-completion questionnaire and direct questions. The research was approved by our local institutional review board. The pain was analyzed from a topographical point of view (main location and type of radiation), the relationship with chewing (A = rest pain that increases with chewing; B = rest pain that does not increase with chewing; C = pain only during mastication) and intensity (NPIS). It was recorded maximum mouth opening and the lateral movement without tooth contact and in a particular way, the opening was not measured between the upper and lower incisor margin but by calculating the overbite. The basic texts of the physical examination were:

- spontaneous opening (painful and/or limited and/or deviated)
- contralateral laterality movement(painful and/or limited)
- and feel or passive stretch (hard and/or painful).

All were repeated during follow-up to monitor the effectiveness of treatment objective (Figures 1, 2, 3, 4, 5, 6).

Place the suspected diagnosis, was requested TMJ MRI performed by machines with at least 1.5 Tesla power and equipped with TMJ coils dedicated. Patients were informed about the type

Figure 1
Physical examination: limited mouth opening and painful.

Figure 2
Physical examination: limited mouth laterality and painful.

Figure 3
Physical examination: end feel stiff with pain.

of pathology, timing and therapeutic modalities and possible surgical option. No patients declined participation in the study. The only treatment for all patients was the use of a pivot appliance. Visit and treatment were performed by the same specialist (not general practice).

The splint is built by eliminating any hook or retention wire, which would result in the extension of the resin on the lingual-palatal side, in order to minimize the footprint and disturbance to the language. Retention is entrusted only with resin that is shaped like the veneers that hug the vestibular slopes of teeth.

It is preferably built for the lower arch but not in an exclusive way because we prefer the rear edentulous arch which is well compensated by extending the splint. The effect is achieved with a single contact as distal as possible from the side of the affected TMJ (Figure 7). The splint has a standard height of about 1-1.5 mm at the molar level and the built location it is detected with a front jig (incisor) and a wax (Moyco Hard Pink) relined (Luralite, Kerr), using an articulator (Denar Mark II) upon detection of the facial bow. The height of contact distracting is based established on the clinical judgment counting the possible loss of vertical dimension of occlusion (VDO): if was think it is significant (missing teeth, dental inclinations, incongruous prosthesis) will be rise distracting rather if is important adding resin on the splint otherwise if there are not the conditions for a loss of VDO (occlusion integrates, report medical history of trauma) are dropped all the tooth contacts except the only distal one. In any case, the distracting contact must be unique, the most distal possible, without creating, in its vicinity, inclined planes on which the jaw can slide (Figure 8). It is used at night and

Figure 4
Physical examination after therapy with parameters normalization.

Figure 5
Physical examination after therapy with parameters normalization.

the first check is done after five/six days proceeding with the following method:

- if the patient reports an increase in pain (not his basal pain but more) or a continuing and disturbing tightening trend, we should reduce the height of the distracting contact but let it the only contact (the splint is in distraction)
- if the patient reports no or minimal improvement, we improve the distracting contact, if this was high from the beginning, or we reduce any new contact that appears extra distracting contact, though it was down from the beginning
- if the patient reports improvement we maintain or shrink any contacts appeared extra distracting contact.

In any case, it is essential that the splint is adapted to allow an eventual protrusive shift of the mandible so that is possible contacts in canine incisor area, must be scrupulously removed. From the beginning, we proceed in the same way, in subsequent sessions, with intervals of about ten days for the period, totally six weeks and at the end, it's evaluated the result obtained. If the patient does not report improvement, the splint is changed in stable (contacts distributed) and then sent to the surgeon for arthrocentesis or arthroscopy. If the patient reports improvement (sporadic episodes of the pain of low intensity while chewing food consistently is acceptable) the splint is modified to stabilize contacts evenly distributed, to the size of the distracting contact and incisive and canine guides that are to pronounced (not steep). During the six weeks of

Figure 6
Physical examination after therapy with parameters normalization.

Figure 7
Pivot appliances.

the distraction therapy, soon as you detect therapeutic efficacy, it is recommended to use it

Figure 8
The inclined plane (in blue) distal to the distraction contact can dislocate the jaw.

for a few hours during the day but never for 24 hours or during mastication. Finally, if a benefit is obtained, we verify if in the side where the distraction was acted, a subocclusion was created and space was released between the arches (presumably the VDO loss) if this is verified, we shall immediately restabilize the interarch contact adding composite or with other temporary solutions, which only later will be replaced by definitive artifacts (Figures 9, 10, 11, 12). The last type of procedure was performed in 36 patients and all had compatible characteristics with a loss of vertical dimension.

After that is verify the benefit obtained, the splint is used for another three/four months and then gradually discontinued except in case of parafunction in which continues to be used as a night guard. After six weeks check, patients were controlled in the first year, every three months, and then, in the next year, every six months.

The side effect of this splint is that the contralateral joint to the treated one, not supported by any occlusal contact in the first two months, may suffer, a compression. About this,

Figure 9
It has been necessary a distracting rise very high.

Figure 10
Was created dental arches space much more accentuated on the affected side.

Figure 11
The space has been offset (filled) with the addition of the provisional resin.

Figure 12
The addition of the provisional resin was only in the back and have not created an anterior open bite (note the contacts)beacause the jaw has tilted.

the patient must be informed that in case of pain he should stop the use.
This problem is controlled by minimizing the difference in height between the two sides eventually adding resin on the contralateral side of the distraction, of course, without this cancels the distracting effect.

Results

No patients withdrew from the study. The intensity of pain at the start of treatment was equal to 5.44 (NPI scales). Relationship with chewing, 81 patients reported rest pain with increasing during mastication, in 5 there was not increasing with chewing and in 14 the pain was present only in mastication. At 6 weeks of follow-up 94 patients had benefited from the treatment with a reduction in the pain score of 87.5% and of these, 68 achieved a reduction to zero in pain, but 3 of them reported short-term pain chewing hard food, while 23 reported a value of pain of 1 and 6 of these with breakthrough pain on chewing. Two patients

reported 2 and 1 patient 3 and, these last three, all with breakthrough pain on chewing. For all patients, the pain was considered acceptable because of episodic, short-term and controllable intensity, avoiding foods very hard (Table 1). In this phase, the intensity of pain for the entire group was of 0.68.

At 2 years follow-up 93 patients declared no pain at rest and during mastication; one patient remained with a value of two with breakthrough pain during chewing of consistent food, then at 2 years the reduction of pain rise to 93.5% in just responding patients. In 6 patients who have not responded to treatment, at 6 weeks, the pain was reduced to 6 which was considered insufficient because these patients had pain at the beginning of treatment of 2.2 higher than the average of the other (7.6 compared with 5.4 in NPIS) and so were sent to the surgeon for arthrocentesis or arthroscopy procedure (Table 2). Four patients, in the period between the first and second year of follow-up, had an episode of recurrent pain lasting about a week that was solved with the reuse splint. The average mouth opening at the beginning of treatment was 37.2 mm, at 6-week follow-up was 42.3 mm, an increase of 13.7%; it was not detected a significant correlation between the increase of mouth opening and pain reduction. At 2 years follow-up to the mouth opening has reached 43.5 mm improving 16,9%.

At 2 years follow-up, according to verbal scales, 90% of all patients have judged the therapy very effective, 4% effective (despite pain relief were not granted a full and straight mouth opening) and 6% not effective. Three patients experienced pain in the contralateral TMJ during the use of a splint, in two patients the problem was solved by correcting the splint while the third, which appeared in the contralateral TMJ, a dislocation with reduction passed to non-reduction.

Discussion

According to the Research Diagnostic Criteria (9), the ADDwor is classified under the second group, disk displacements, where it is further divided into displacement without reduction with limited opening or aperture without limitation. Usually, patients report pain in the preauricular region or in the ear sometimes irradiated to the temporoparietal area (configured as a headache) or the cervical area (configured as generic cervical pain). Can result in mandibular limited movements (opening and laterality) and less frequently otologic disorders (feeling “closed ear” or compression-ear). In some cases, especially in young subjects, it may be asymptomatic and relief in the course of

Table 1 - Outcome at 6-week follow-up, patients in grey with breakthrough pain only to chew hard foods.

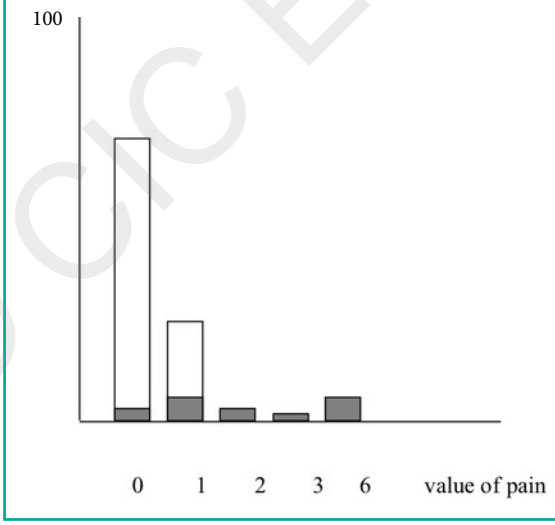
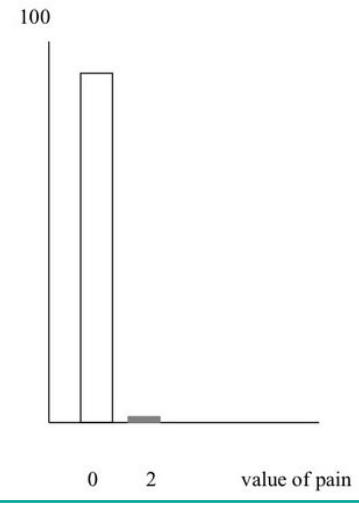


Table 2 - Outcome at 2 years follow-up, patients in grey with breakthrough pain only to chew hard foods.



investigations for the contralateral TMJ. ADDwor instrumental diagnosis is formulated when the disc in the closed mouth sagittal images, it appears displaced from the position considered physiological using as a reference both criteria currently in use (10, 11) and also in the images with open mouth, the disc remains dislocated before condyle (Figures 13, 14, 15, 16). The disc dislocation is almost exclusively in the anterior-medial direction (Figures 17, 18). In case of ADDwor the bilaminar area may undergo to fibrotic modifications (12) until the formation of a "pseudo disc" (13, 14) that can be interpreted as a form of adaptation to loads, this should compensate the absence of the disc and theoretically ensure a less intense symptom (Figure 19). It is believed that, despite the presence of ADDwor, the mandibular function can be almost normal and without pain (7, 15, 16), that the mouth opening increases spontaneously with time (17) (Figures 20, 21) and that there may be a spontaneous improvement (8, 18, 19); finally, an altered anatomical relationship between disc and condyle, is not indicative of malfunction of the TMJ or need of treatment (20, 21).

But, in the face of all this, it is correct not to take any treatment and advice, waiting for the evolution of the disease is still unpredictable from subject to subject, that there is no correlation between MRI picture and prognosis, the adjustment period is generally greater than 3/6 months and that its chronic pain involves physical reactions and psycho-behavioral, adding to joint damage, carry out a vicious circle difficult to resolve?

The hypothesis that a pivot appliance, adapted according to the method, can be effective in the treatment of ADDwor has been demonstrated by this study. The presence of pain before therapy, not more than 4 months plus 6 weeks of verification of the efficacy of the splint realize a period of time less than that considered necessary for spontaneous recovery, chance, the latter, however, is not common to all patients.

The pivot appliance was mentioned in 1956 by Sears (22) and has been proposed to accentuate the effect of distraction in patients with internal

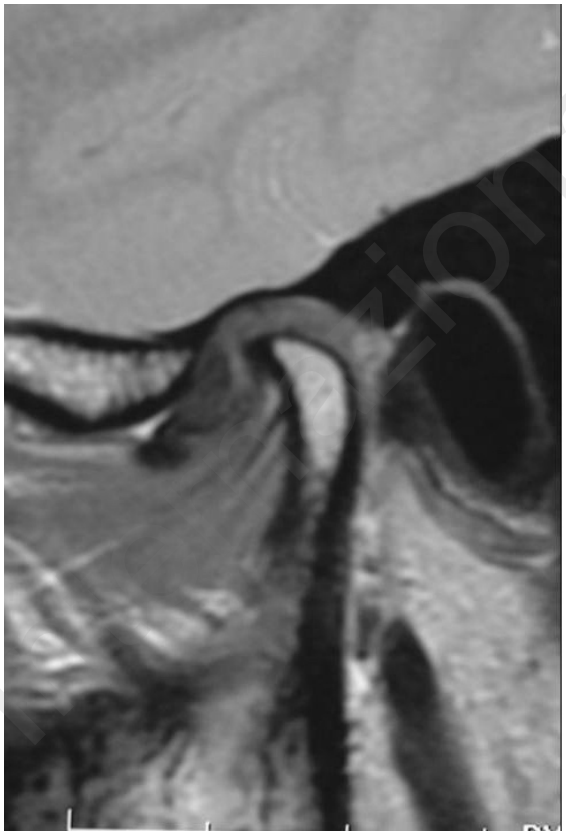


Figure 13
The disc is displaced when the mouth is closed and opened.

derangement (23). The rationale of this splint should move the contact distally respect to the point of application of the maximum strength of the elevator muscles, which corresponds to the area of the first molar, so to rotate the jaw around the fulcrum constituted by the pivot causing a distraction of the condyle (directed downward movement of the condyle) and then a decompression of the TMJ (24). But this effect is a real distraction? According to Seedorf, Scholz et al. (25) if the jaw is free to move forward there is a significant lowering of the condyle while if the protrusion is prevented, there is even a lift of the condyle with a not desired compression, whereby the downward movement of the condyle would be only due to the protrusion. Demling et al. (26) comparing the effects of stabilization of a pivot appliances on the position of the condyles,

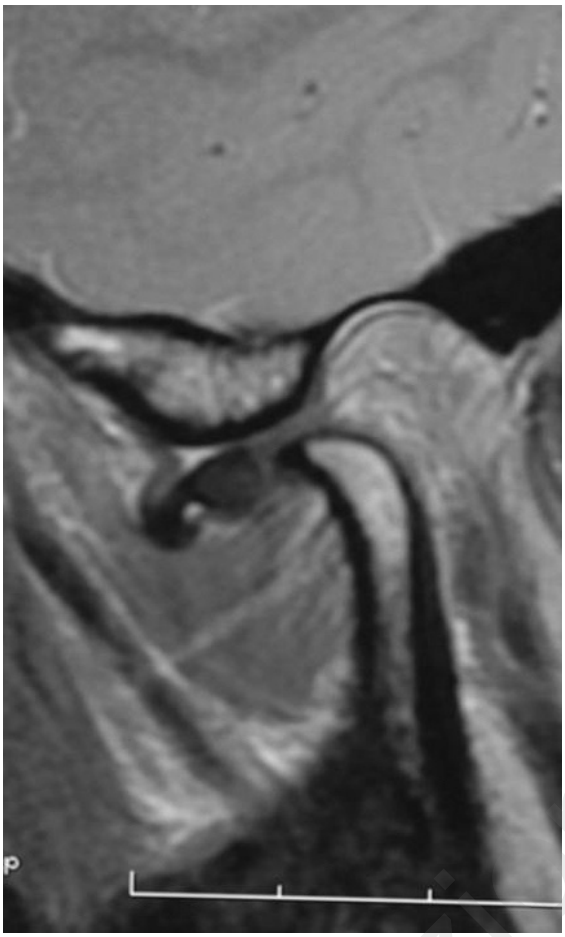


Figure 14
The disc is displaced when the mouth is closed and opened.

registered with an ultrasound-based registration system recognize that both appliances cause a shift of the condyles but that, according to the Authors, should not be considered a real joint distraction but the effect of the altered interocclusal vertical dimension. According Linsen et al. (27) does not produce a distracting effect on the condyle with the use of a pivot, but used in combination with a chin strap (sling chin guard) is realized an effective distraction. Also according to Schmitter et al. (28), the only pivot appliance does not produce any joint movement. Takanashi and Ito, Gibbs et al. (29, 30) using an electrical jaw - tracking devices have shown a shift of the condyle on the distraction side and the compression of the contralateral TMJ, similarly Hironobu, Shinichi et al. (31) using overlapping tomograms confirmed condylar displacement but with different magnitude and direction and with different values between the various actors.
Sato et al. (32) confirm the presence of a condyle displacement with a rotatory component but also with a rear and top translation movement between 0.2 and 0.63 mm. In this study, the position of the condyles is evaluated with TMJ tomogram that certainly does not provide a three-dimensional image of the intra-articular rela-

Figure 15
The disc is displaced when the mouth is closed.

Figure 16
The disc is displaced with mouth open, there is a light liquid film and the stretched retro diskal ligament.

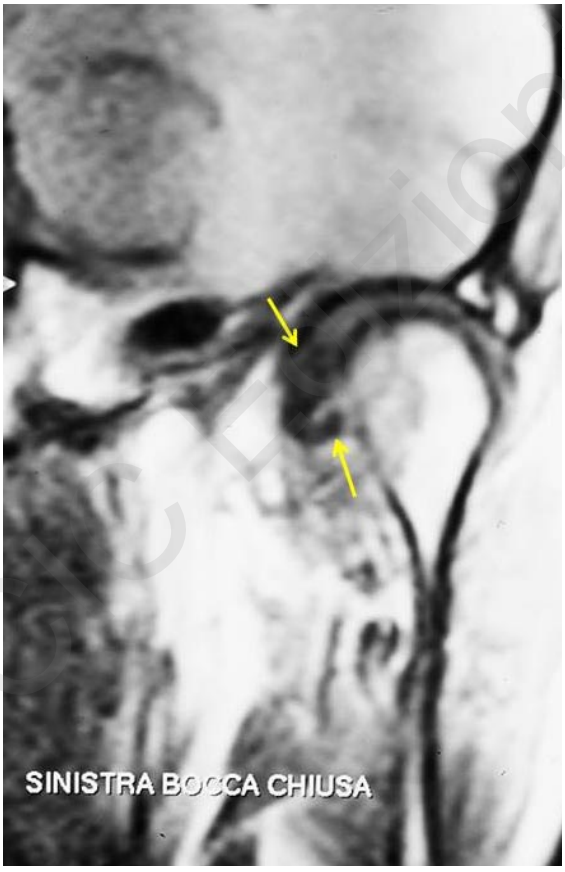


Figure 17
Coronal projection: the disk (arrows) is fully displaced.

Figure 18
Coronal projection: the disk (arrows) is partially displaced.

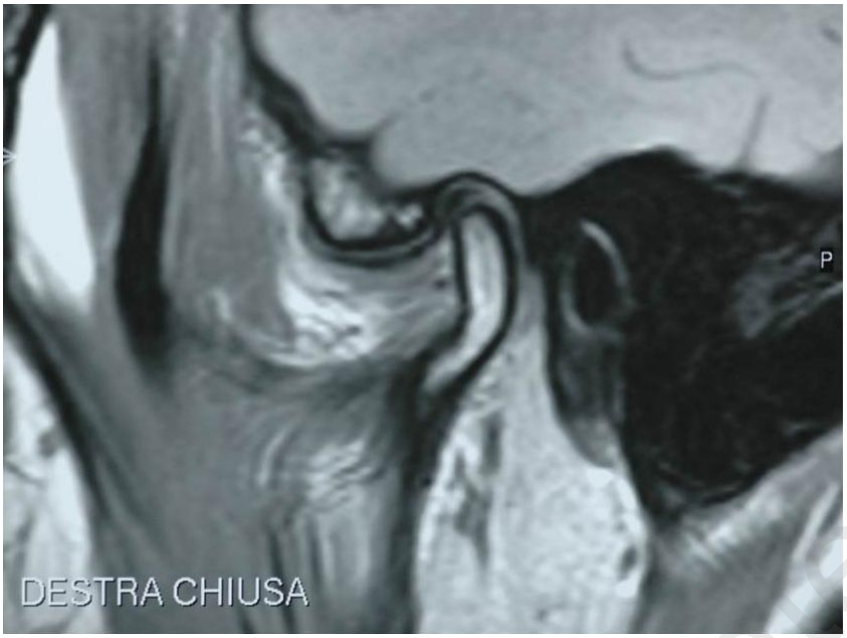


Figure 19
The thickening of the retrodiscal ligament creates a pseudo disk where the disk is not distinguished.

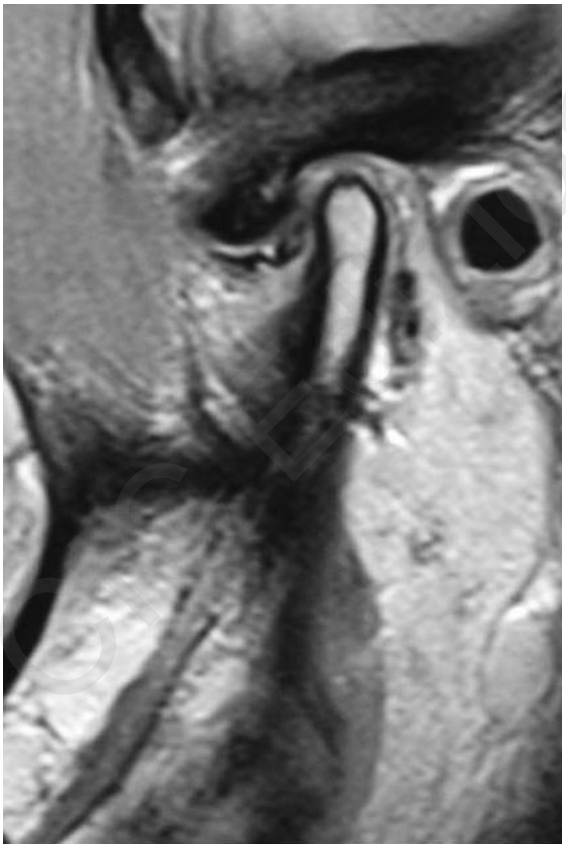


Figure 20
Despite the disc is displaced without reduction the condyle moves completely allowing a normal opening.

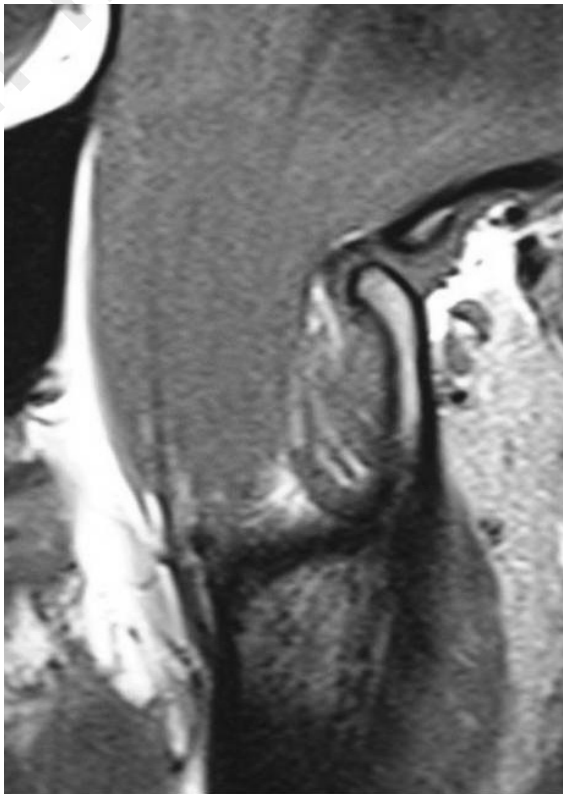


Figure 21
Despite the disc is displaced without reduction the condyle moves completely allowing a normal opening.

tions. According to other Authors, however, there is a genuine condylar movement (anterior downward movement), but this occurs even with a splint stabilization. Hugger et al. (33) using images in MRI have shown a distraction average of 0.6 mm (with a maximum value of 2.6 mm) with a bilateral pivoting. The results of this study are partially concordant with those reported by Moncayo (34) where a pivot bilateral determines an average condylar lowering in 87.5% of the subject, but a real bilateral condylar distraction in 30% of the subjects. In this study, contact was distracting was placed at the level of the second molar with the possibility of harnessing the forces of the muscles above and below nodes and orbicularis muscles to cause a superior rotation of the front of the jaw, then a distraction of the condyles and preventing TMJ overloading. We note that in Moncayo study the adjustment was not individualized but for all the subjects was 1.5 mm, and they were always healthy subjects. The clinical and experimental study of Festa and Galluccio (35) confirms the possibility of obtaining an increase of the intra-articular vertical dimension with correct orientation of the collagen fibers in rats TMJ using a splint that causes a distraction by spring-shape. Even Ettlin et al. (36) have shown that an increase in molar level causes a change in the intra-articular relationship and then a redistribution of contact surfaces condyle-fossa.

More prospective studies have shown an improvement of subjective and objective parameters in patients with TMD (37-40), but there is no certainty about the actual efficacy and mechanisms of action of the splint. The study of Kuboki, Takenami et al. (41), conducted in patients with ADDwor showed that neither a unit of stabilization and one of mandibular repositioning caused a change in intra-articular relations, despite the symptomatic benefit reported by patients, which was attributed by the Authors to change clenching behavior, possibility emphasized by Clark et al. (42) to explain the effectiveness of occlusal appliances in temporomandibular disorders. The pivot appliance with chinstrap with posterior superior traction in 60 patients with symptomatic internal derangement brought in 71.7% of cases, fully asymptomatic in a study of Lous (43). It could, finally, be assumed that the stimulation of periodontal receptors, by the upward pivot, causes a reflection effect on the masticatory muscles. A short and decisive contact on a single tooth causes an opening up reflection to a complete inhibition of the elevators muscles (silent period) (44, 45) and Boyd (46) in an animal study found that a unilateral contact causes on the same side a reduction of muscle activity and a reduction of the particular load and vice versa in the contralateral TMJ. Locking against interference in maximum intercuspidation, as is the pivot, results in a reduction of the electromyographic signal (47, 48).

Most of the studies (25-27, 33) that assess the effect on the position of condyles with pivot appliance use bilateral increases, very rare clinic condition where the vast majority of cases is symptomatic, at the same time, just in one articulation. In our study, for example, in a hundred patients, 20 had lesions at both TMJ but the only one reported pain bilaterally.

It also must be noted that all studies (25, 34) were performed on healthy subjects so with a preserved joint anatomy and one wonders whether the action of the splint has the same effect on an integrates TMJ compared to a pathological TMJ where the intra-articular relations and the position of the condyle are inevitably modified by the lack of the disc. In the examined studies the height of the distracting adjustment was arbitrary and different, ranging from 0.2 mm (35) to 0.6 (27), up to 1.5 mm (34) and never adjusted during the sessions to the individual patient and in one case (31) pivots were made of metal pins, not used in clinical practice. The distracting effect was evaluated when the appliance was placed, condition very different from the clinic where the splint was used for weeks. The only study (35, 49, 50) where it is used for months involves symptomatic benefits. Furthermore, in several studies, it is not comparable the position of the jaw with the inserted splint: it is in the usual position, or in centric and how it is recorded; similarly are not comparable the closing forces, remarking that

are voluntary acts instead of spontaneous motor automaticity as it does when the splint is used for therapeutic purposes. The possibility, therefore, that a pivot splint causes a joint distraction remains controversial, and there are significant differences between the experimental and clinics conditions.

About the splint we use is important to observe that:

- The distracting markup is unique and the most distal possible. Marks up at the level of the first molars or distributed over several teeth have not given the same results
- The height of the distracting contact is not casual or standard but adapted to the case. The splint adjustment, following the symptoms reported by the patient, are critical to the therapeutic efficiency and make all this an original method
- Equally important, if the use of the splint resulted in the release of occlusal space between dental arches, is the restoration of dental contacts
- The device must not in any way prevent the possibility of mandibular advancement, especially as often in ADDwor and OA the condyles are retruded
- The splint is built in such a way as not to present any lingual bulk and not to interfere with the neutral lingual space with the risk of making go back the tongue, and so the jaw
- The evaluating period for the effectiveness of therapy is less than the time in which it was observed, for some patients, a spontaneous improvement.

Conclusions

The distracting splint built and operated according to the method has effectively proven in the treatment of pain in case of ADDwor. The action time is very short and can be easily used by the patient thanks to the small footprint.

The therapy has proved quickly effective for spontaneous pain, but some patients experienced pain when chewing consistent food, however, it was resolved within three months of starting therapy. It was impossible to correlate these events with any significant factor.

It was also effective in improving the range of motion but with less significant results compared to pain control probably because it has no chance to restore the correct intraarticular relationship.

Has as a side effect the possibility that the contralateral articulation undergoes to compression, which is deleterious especially in the presence of articular lesions as the disc dislocation with reduction, but the careful management of this aspect minimizes the problem.

In some patients, the splint, has proven quite useless requiring a surgical procedure. In any case, the effectiveness and non-invasiveness of this therapy make it the first choice compared to surgery.

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