Exploring Tooth Movement
The Hycon Precept

DR. WINFRIED SCHÜTZ
Acknowledgements

- When the Hycon was started in the early ‘80s it was not so easy to promote this ‘new’ idea. Especially without real support of any orthodontic company.
It was Dr. Reinhard Kersting, one of the first users, being conviced and enthusiastic, who gave me feedback and critics.
Even more important: More than once he succeeded in persuading me to continue.

- Having taken a look at a model with the Hycon inserted, it only took about one minute for Dr. Richard P. MacLaughlin to realize its benefit. Since then he has commited himself to spread the Hycon-idea. He even has given impulses for improvement.
Selflessly following his conviction he did this completely for free without taking any personal benifit.
For me an encouraging experience in competence, sovereignty and humanity.

- Before he came across the Hycon, he had already done some experiments basing on ideas similar to the Hycon principle.
So it was not a big step for Prof. Dr. Anmol Kalha to comprehend its clinical relevance.
But it was a sovereign decision then to use the capacity of his Department of Orthodontics at the University of Davangere/ India to do profound and independent research on space closure with the Hycon.

- To filter out the essential substrate from the big pool of usefull, interesting, important and useless informations which belong to a topic may become wearilysome. To make a story out of this is another challenge. Dr. Anikke Lehmann and Dr. Paul Bingler were critical colleagues to support and accompany me and to help me keep on track.

- It was Claus Schendell from the Adenta Companies, who, as non-orthodontist, had no difficulties to comprehend the Hycon.
‘Consequently’ he decided to produce and to sell it. From that time on he has really cared- without his generous support we would not have gone so far.
And the whole paper would not have been realized without the tremendous help of Lorraine Porto, the President of AdentaUSA.
She is ‘responsible’ for the complete appearance of the paper and for all those ‘little’, invisible, often dull but important things as well.
I am responsible for the mistakes.
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* These articles provide additional separate information
Exploring Tooth Movement – The Hycon Precept

DR. WINFRIED SCHÜTZ

“The screw is one of the oldest elements of force used in orthodontics (cf. The Schwarz Retainer). Its function accepted by and familiar to every orthodontist, allowing the handler to apply an exact defined pressure to the periodontium. Due to this principle, the orthodontist should be able to fulfil task with no difficulties. The defining aspect of the Hybrid Screw is that its capacity goes beyond that of a standard screw, forming an impeccable functional unity with the help of a multiband apparatus, preferably the “straight-wire-technique”. By working with the multiband appliance, the “new force element” eases the job and can offer new ways of treatment…”
(from the introduction of a paper on the Hybrid Screw presented in 1984)

Introduction...
2011

This paper aims to give more insight into the ways in which the Hycon-screw works. The way it functions is illustrated in more detail; the biomechanical-physiological aspects of orthodontic tooth movement are demonstrated and the methods of treatment are examined explicitly. The intention is not to formulate, or even replace an enhanced instruction manual, but to provoke an openness to a different perspective and its consequence in the world of space closure.

“How much force does the HYCON exert?”

This is the number one most frequently asked question when on the topic of the Hycon-screw with my colleagues. Above all many users naturally have the concern that the Hycon-screw could over-exert the periodontium. Within this new and different mechanical principle, and unlike the elastic space closure mechanisms, the matter of force plays a secondary and merely passive role in the procedure with the Hycon-screw.
Looking back…
Beyond 1982

The original idea of the Hycon appliance was first created in the early nineteen eighties. At this point in time the HYCON, almost visionary, was called the “Hybrid Screw” - consequently the term HYCON arrived from “Hybrid contraction”.
From this a new treatment was to be created, one in which a technique involving fixed elements would be combined with one involving removable elements.

When I first started looking into an alternative for the loop mechanism for space closure - in those days I was still a training assistant in the practice – I did so for two reasons. On the one hand, I was uneasy about the stress produced by the space closure process and on the other, the activation of the loop including bending the arch wire - mainly distally from the second molar - was unpleasant. It was customary to perform the space closure with the .021”x.025” closed-loop arch, which did not make things easier. I can safely say that the individual bending of the contraction arch including the adaption to the dental arch and alveolar process, often having to be performed under time pressure, was not one of my favourite tasks.

The idea of the screw first came to me rather spontaneously, when I saw a picture of a turnbuckle. Getting this into a fairly “mouth-sized” shape was an interesting, and at times thrilling, technically-mechanical challenge.

The Result: A bolt and nut combination with a .014 inch pitch of the bolt in which the holding pin is mounted to the nut. The holding pin is to be inserted into the auxiliary-tube of the molar band from the mesial side and bent back. Around the neck of the bolt, a ligature wire is twisted and bent away from the bolt to be connected with another tooth/several teeth beyond the space. (Compare instruction manual)

The first “Hybrid Screws” - 1982 -

Fig: 1  The first two hand made prototypes of the “Hybrid Screw” assembled for example from a drive and housing of an expansion screw, a mandrell, a ball clasp and a piece of archwire.

Fig: 2  Hyrid Screw inserted (please don't blame the filling on me)

The primary purpose was to simplify the space closing process and save chair time. In comparison to the procedure with the loop mechanism (changing of the arch wire, loop bending, taking the tooth-/alveolar ratio into consideration, activating etc.) the experiences with the prototypes alone were very promising.
I was used to hearing the complaints of pain after activating the loop (“according to the regulations” 1mm), which did not occur after turning the “Hybrid-Screw”. One patient, who was converted from the contraction arch mechanism to the screw, complained afterwards of previously having been maltreated with the contraction-loops.

In terms of using the screw, I at first oriented myself by the instructions for the “Schwarz retainer” and stayed - intuitively - under the 0.008” /0.2mm margin, the measurement of the periodontal space. I, of course, checked weekly, activated it myself and found it to be “more pleasant”, being able to apply it stress free in “small steps”. The spaces were reduced significantly; the screws had the desired effect.

**Space Closure Report 1**

1a 1b

2

3a 3b
Case: A 14 year old boy with Class I occlusion and deep overbite. Spaces distal of the lateral incisors and dento-alveolar midline shift to the left in the upper jaw

Aspects of treatment: The deep overbite being extreme, an intrusion step was bent distally of the upper lateral brackets to support levelling. It was started with a slight intrusion step in the .016"x.022" archwire (.022" slot system) then archwire dimension and intrusion steps were increased subsequently. After .021"x.025" archwires were inserted, it was time for space closure. A combined retraction with simultaneous gentle(!) intrusion of the upper front were intended.

The space closure: As the space distal 12 was by far the bigger one, space closure was started in the 1st quadrant only. The Hycon was installed there. The patient was instructed to turn the screw 2x 1/2 a turn per week and to wear headgear during the night.

Fig.1a /1b: Hycon in place (close up), occlusal view.
Fig.2: After working a full range, the Hycon in the 1st. quadrant is reactivated, the other Hycon is inserted in the 2nd. quadrant.
Hycon in 1st.quad. to be turned 2x 1/2 a turn per week, Hycon in 2nd. quad. to be turned 1x 1/2 a turn per week. Headgear to be continued.
Fig.3a /3b: Situation about 6 weeks later. Space distal 12 is reduced significantly, space distal 22 is closed. As the length of the archwire (especially) between 13 and 12 is reduced, the elasticity of this part of the archwire has decreased accordingly. Consequently the intrusion force there has slightly increased. (c.f. Fig.1b)
Fig. 4a /4b: Situation with space closure completed. The midline is correct, the deep bite is improved.

Assuming a tooth movement of 0.040" per month, in a reciprocal space closure this corresponds to a distance of 0.080" - justified a turning of the screw by 1 turn twice a week. From this activation, meeting a pitch of 0.014", resulted a calculated closure of 0.028" per week. It was received well by the patient, was efficient and consequently became my standard amount of activation for the reciprocal space closure, although the activation distance was above 0.080".

An important fact to remember is that teeth, when in “orthodontic motion” - thus in a different state of response – possess an enlarged periodontal gap in form of a zone reduced in density. This argued for the rate of activation mentioned above.

It soon became clear, that the successful first observations were neither coincidence nor of occurrence. Not only was the treatment simplified, but also found to reduce pain and speed up the space closure.
I asked myself what other things the screw was capable of doing and more so, what the cause behind this was.

One thing was sure; my experience with the active retainer - the starting point of my consideration - was of little help.

**Starling’s model**

A possible doorway presented itself when I worked on the pressure ratio in the tissue. I happened to come across a tabular figure showing Starling’s model of the final part of the capillary system. It allowed me to assume similar proportions or principles for the periodontium. I learned that the effective capillary pressure consists of only 10 to 15mm Hg.

The pressure generated by the amount of force created by the loop (not uncommonly amounting to 600 cN) thereafter exceeds the physiological capillary pressure. The necessary blood circulation of the tissue is no longer warranted. However, the fact that the upkeep of blood circulation is the highest premise for efficient tooth movement has to be held against that.

**GRAPH 1:** Illustration of Starling’s model

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**Reflections – on the notorious?**

Many a things are obvious, but not consciously

Working on the typodont can be helpful; one directly sees the results of ones “therapeutic measures”. In an instant, following the heating of the wax, one finds the teeth move to where expected – or not.

Working on the typodont can, however, make you not only forget the multiple mechanical problems which are difficult enough on their own, but also the key role in vivo metabolic processes play.

It is commonplace and I almost shy away from pointing it out. But being as self-evident as they are, I have found the “old truths" often to be ignored – their informative capacity dwindling - living on as an empty shell, empiricism replacing knowledge. Standard values, averages and benchmarks creating a false impression of security. Naturally this process is useful in allowing the mastering of immense amounts of information – respectively knowledge - and making efficient acting possible.
It becomes problematic, however, when empiricism turns into nonchalance. It is therefore in my opinion questionable when, as is shown in the example of the tooth movement, the inquiry about the “right amount of force” is reduced to the statement of “between 50 and 220 grams”. This does not do justice to the phenomenon of tooth movement!

Let us now look at what happens when teeth move. This process is a very interesting, and actually fascinating one. Based on the vast impact this apparent problem has on the day to day treatment, these invisible processes, which occur in the alveolar bone, its surrounding areas and beyond, must be taken into consideration. It is worth existing in our awareness other than as the information “right amount of force = xy gram”.

More than anything, the correct processing of the metabolism, which we influence, is vastly influential on the course and success of the entire treatment, particularly the procedure of space closure.

**Tooth movement – a kaleidoscopic consideration**

*What do an iceberg and the moving of teeth have in common? They are both impressive, largely concealed, and a potential hazard.*

*When considering the moving of teeth one cannot help but think of osteoblasts and osteoclasts. But what are the prerequisites for these cells to work; or even initially to emerge? What must first occur on a cellular, humoral, biophysical or biochemical level? And what else happens?*

*It is fascinating to see how and in what manner the organism tackles the task of “tooth movement” and how it for instance reacts to a non-physiological irritant, able to manage instances from simple disorder up to catastrophe.*

*Although many proceedings are still outstanding, it for instance still being unclear how the signal transmission of the external, mechanical burden into the cell nucleus exactly works, it is without a doubt that what underlies in the movement is a highly complex process. With this for example, the “simple mechanical stimulus” has an impact all the way to the nucleus. After enabling the transcription factor, it eventually comes down to genetic reprogramming (!); the osteocyte (once again) turns into the osteoblast.*

*There are diverse intra- and extracellular informational, steering and signalling systems present. Neurotransmitters and sexual hormones play an important role.*

*As an overload protection and to optimise profitability “feedback control” mechanisms intervene.*

*Within the periodontal tissue, the masticatory system also has an “ancient” buffer mechanism to its disposal in form of a fluid system, with its partially thixotropic features.*

*To ensure the task of the “protection and maintenance of the tooth” occasionally several reactions occur simultaneously, all of which fulfil the same task – or does one of the reactions even constitute as the emergency plan?*

*…in the case of damage (e.g. necrosis, hyalinization) there are the “repairing mechanisms”.*
With this, the greater the damage, the greater the reparation effort and the longer the healing process. “Restitutio ad integrum” is the goal, yet a full restoration of the periodontal ligament as well as the replenishing of the resorption lacunas are not always possible. The hyalinization does not illustrate a normal physiological phase in the tooth movement, although it can almost be assumed on the basis of accounts found in literature.

Conclusion: The smaller the damage, the more effective tooth movement is.

The process of the tooth movement in the tissue quite resembles an inflammatory process – and is likely to demonstrate a special variation of it.

As a response to the noxa “alteration of the hydrostatic pressure”, vasodilatation and an increase in permeability of the capillary vascular system occur, amongst other things. Goal: Optimising the blood circulation as a prerequisite for an increase in metabolism.

Clinically the most obvious is, however, the heightened mobility grade of the teeth, as a propagation sign of the enlarged periodontal gap. Surely, it will have developed a highly reactive zone here, which has functionally adapted to the change in hydrostatic pressure. The organism responded to the noxa “force” with an increased tolerance and can now continue to react – in terms of an avoidance response, namely tooth movement. It goes without saying, that this response requires much more energy than when in hibernation. This is, concerning the compressive load, programmed for the occasional food shredding. Not by chance does the tooth movement have ATP serving as an energy supplier (energy storage) and parent substrate for various cell reactions at the beginning of a chained reaction (keyword: second messenger).

The differentiation of monocytes to osteoclasts and osteocytes to osteoblasts are only two of many processes.

An even halfway detailed discussion on all aspects of tooth movement, not to mention to the extent of their comprehensibility, would exceed the framework and topic area of this work on the respective processes in the realm of periodontal tissue. If not yet the case for some, I may have succeeded among other readers to arouse awareness and respect for the delicate, highly complex process of tooth movement and potentially brought about a certain curiosity.

Summarizing, we can assess:

**Whether biochemical reactions, hormonal processes, nerval activities or even genetic reprogramming – everything comes down to metabolism.**

**But: No blood flow – no metabolism**

**Returning to the practice**

Literature asks for “the minimal effective strain” to be found within tooth movement. This is easier said than done. The minimal effective strain sounds good is, however, far too vague to tangibly help things along. Conditions for the metabolism that stimulate, sustain and maintain the course of alteration processes are required.
As is well known, we have a heightened cell activity as teeth move, that is linked to increased energy requirements, - an “energy problem”. We thus have biochemical reactions. These use up substrates, thereby metabolites that require disposal incur - a “logistical problem”.

From this follows, for one, that the blood flow must always (if possible) be guaranteed, concerning blood supply as well as blood discharge. Secondly, the tissue requires regeneration phases, to for instance attend to metabolic tasks, balance out the pH-milieu, or to replenish the internal energy depots. 

Note: The activity of many substances involved in metabolic occurrences is dependent on the pH-value and nothing works without the ATP.

From a therapeutic point of view, a technique is required which allows the orthodontist to fulfil these claims in the first place. The development of the multiband/multibracket technique in orthodontics was indisputably the dawn of a new era. It is possible to determine and reach goals in treatment that are in line with a healthy, eugnathic denture – largely, independent from the findings.

“In the past” one could only dream of this.

An inevitable component of the “fixed technique” is illustrated by an “elastic element of force”. The “elastic element of force” uses the elastic characteristics of the materials. It is practical, easy to handle, and partly, as is within the domain of arch wires, there is no alternative. Moreover, being technically simple, often it is also relatively cheap.

The treatment with elastic forces, however, reveals a larger problem, when for instance inquiring about the “ideal arch wire” or asking “How much force the Hycon has?”

When applying it to orthodontics at least, it is impossible to accurately define, control or reproduce the “elasticity of force”. This is a grave disadvantage when considering it, as too much impact of force on the tooth can result in damage to the roots as well as to the periodontium. In this context the most common phenomenon should be hyalinisation, the most uncomfortable the issue of root resorption.

Since “Standard-Edgewise” has been state of the art – which I think back to with mixed feelings – there have been immense developments in the scope of treatment hardware. From the introduction of the pre-programmed “straight-wire” appliance to the super-elastic wires, their foremost task was in terms of simplifying the work and increasing their efficiency. Beyond that, they allowed an increasingly gentle treatment.

It should not be ignored, however, that the “elastic element of force” has one intrinsic disadvantage.

With “elastic forces” – actually a bizarre term when describing the reset force of elastic materials – the force that should be generated is proportional to the extent of the activation, so when stretching and bending. This also means, to generate the same power, materials with a high reset force require less stretching (deformation) than materials with a low reset force. It becomes obvious when comparing the flexible features of a steel arch, a NiTi mainspring and an elastic chain.

In general one can say that the more force we need the longer the activation-stretch has to be - and that both factors cannot be dissociated. Once activated, the stretched elastic element tends to re-contract to obtain its initial shape. As, compared with the amount of re-contraction, the distances within the periodontal structures are
comparatively tiny, finally a permanent pressure corresponding to the activation force results in the periodontal tissue.

However, what is force needed for within the task of moving a tooth?

From the basic intention, it is to achieve adequate tissue reaction. From physiologic knowledge, only little force is need. A considerable amount of additional force is required to overcome the friction within the mechanical system of the fixed appliance being located where bracket-slot, archwire -and ligature- meet. 
(In this context, two kinds of friction occur: the ‘static friction' and the ‘dynamic friction’- but that would be another topic).

As soon as the friction is overcome the surplus of energy runs into the periodontal structures. Here the problem arises when this energy exceeds the captivity of the tissue. Unfortunately, its purpose is not to be the buffers for uncontrollable elastic force.

**Seeking to find the “ideal force”
Are we searching for a phantom?**

The search for the “ideal force” has been taking place for a long time within orthodontics. The data lies between “50 and 220 grams” – or gram force or joule; or even Newton? It seems to me, however, that this pursuit is potentially incorrect, because it is very questionable if there is such a thing as an “ideal force” or if it even exists; and how it can bio-mechanically be applied precisely to work at its most effective.

A study on the possible effect of strain on cell cultures of humane fibroblasts not only revealed that a pressure of 27 cN/cm² was enough for a cellular reaction, but rather that the necessary minimal amount of pressure varied greatly.

Sets of teeth show vast differences within themselves, so at most one could say they all require their own individual “ideal force”. But who is to determine this force?

It is after all dependent on many factors, some partially variable themselves, like in the shape of root and size of root surface, or system related, for instance through the metabolic status. As is well known, the metabolic adjustment of a juvenile is considerably more favourable than that of an adult – and medication can have astonishing effects, amongst other things also on the periodontal-tissue’s metabolism (cortisone).

An important point, that also puts the question of the force further into perspective, is additionally illustrated by the kind of tooth movement. There is a grave difference in whether it is tilting – this also includes the drift along the thin arch – or bodily. (This problem is an old one too; it has already been discussed by A.M. Schwarz.)

In this anyway incomplete list the question whether the continuous or intermittent force is preferable, cannot be forgotten. About this too, there are ample contributions.

Based on the need for adequate metabolic conditions for the tooth movement to occur, the following problem arises:
How does the practitioner know to what extent the activation should be conducted, when the many varieties of factors involved, such as modulus of elasticity, the arch’s friction (static/dynamic),
varying root surfaces, individual metabolic status etc. have to be taken into account?

The orthodontist consistently juggles with these factors, striving to create the right force at the right place, thereby leaving the search for the optimal pressure for the initiation and maintenance of metabolic processes up to chance.

Adding to this, the state of the teeth and periodontium is a permanently changing one and with it the amount of force needed.

The fact that the tooth is fixed rigidly into its bone socket, does not make the demand for sufficient blood supply any easier.

Ultimately, in the hope of being on the safe side, the situation is handled empirically using “moderate force application”. Luckily, owing to its high tolerance range, the healthy, flush organism evidently/seemingly (depending on one’s point of view) does not take even a forceful approach badly.

As long as there is no technical alternative one just has to accept it.

This is true – apart from one exception: **the space closure.**

In the form of a contraction screw, as described at the beginning – called “Hycon” – there is a wholly different mechanical principle at hand.

*By that, the question on force is revoked.*

**But why should the mechanics of a screw be advantageous?**

**Because forces clinically cannot be controlled – but distance can!**

Contrary to the just described characteristics of elastic elements of force, were deflection and strength cannot be disconnected, a screw mechanism enables to separate between these two factors. A screw generates its full strength just when the bolt starts being turned. And – with the bold starting to turn the screw starts to cover distance. The turning of the bolt is direct proportional to the screw movement.

This means the tooth's movement or even that of a whole group of teeth is solely determined by **two clearly defined factors:**

- The pitch of the bolt – the distance
- The amount of turns of the bolt carried out – the multiplier

In connection with this, the screw's force only plays a role insofar as being adequate enough to overcome any amount of frictional force. “It does not generate any additional dynamic force”

This is a very important point for the understanding of the Hycon Principle.

After the adjustment of the Hycon screw the appliance is once again passive.

- There are no existing elastic forces!
- The activation has resulted in a limited increase of “tissue pressure”.
- The physiological stimulus for the desired alteration processes is given.
The whole “system” consisting of the orthodontic appliance, including Hycon teeth and periodontium, is relatively rigid and in itself passive; no elastic force is in operation.

This system swims “figuratively speaking” in the hydro-pneumatic system of the periodontal gap.

- We will see later, that this has important impact for the anchorage.

Conclusion: The functional principle of the Hycon is easier to understand when thinking not in terms of “force”, but rather in “distance”.

An interesting investigation idea from India:
Alkaline phosphatase as an indicator substance

The alkaline phosphatase (bone specific also known as bones alkaline phosphatase (BAP)) is an enzyme that is active in the alkaline milieu. It is generated as a by-product of bone synthesis, produced by the osteoblasts and additionally serves as a marker for bone regeneration processes. From this Prof. Dr. Anmol Khala concluded, that out of the quantity of measured alkaline phosphatase the activity of the bone metabolism and consequently the rate of bone turnover can be determined.

Data reported by Dr. A. Khala 2005.
His experiment consisted of measuring the concentration of alkaline phosphatase in the gingival crevicular fluid of the shifted tooth. Here, the teeth - divided into two groups – were moved by different mechanisms. Group 1 was drifted by sliding mechanics, while with group 2 the Hycon was put into action.

After a 3 week treatment period, there was a significant difference in the amount of alkaline phosphatase. Based on the phosphatase level of unmoved teeth, set at 100 percent, a considerable increase could be discovered in both groups. While in group 1 there was an increase of 65 percent, in group 2 (the Hycon group) the measured level of increase was found to be approximately 140 percent. This indicates that group 2 had the highest metabolic activity.

Consequently, the largest rate of bone turnover and hence quickest tooth movement took place here.

The activation of the Hycon
An arithmetical approach

Please note: all measurements have been rounded.

The distance of space closure (AD) resulting from the Hycon activation, which is relevant for tooth movement, is accurately determinable and reproducible. One must merely multiply the pitch of the bolt (PB), amounting to 0.014” with the number of times turned (AR).

Represented as a formula: \[ AD = AR \times PB \]
Hereby meaning:

- \( AD \) = activation distance – in inches
- \( AR \) = number of turns (activation rate)
- \( PB \) = pitch of the bolt = 0.014” (constant!)

Because it is more important, when giving the patient instructions, to know the number of turns needed to reach the desired closure, reformulating the equation to result with \( AR \) is found to be more practically relevant.

Thus, the formula now is: \[ AR = AD \div PB \]

When, for instance one should activate by 0.008” this accordingly means - in number of turns:

\[ AR = 0.008"(AD) \div 0.014" \text{ (PB-constant)} = 0.57 \]

In this case, the patient would be instructed to turn the bolt 0.57 times, which is, admittedly, not practical.

Here, therefore, is a further step in simplifying activation of the screw for the patient:

We assume that the movement rate of a healthy tooth, under normal circumstances amounts to about 0.040” per month. Additionally, as reciprocal space closure is planed, consequently movement occurring equally at either side of the space.

Thus, the Hycon's over-all activation distance must add up to 0.080” per month (!). Due to the desired intermittent mode of operation (more on this later), the Hycon was to be activated twice a week, thereby the following calculation arises:

With an activation distance of 0.080” per month, the weekly space closure amounts to 0.020”. Being activated twice a week the amount of space closure, therefore, consists of 0.010” each time. This (calculated) results in there being a movement of 0.005” per activation on either side of the space per activation.
As, once again, the number of times to be turned (AR) needs calculation, here too the formula AR = AD ÷ PB is applied:

In numbers: AR = 0.010” (AD) ÷ 0.014” (PB) = 0.7 turns

The so called activation profile, which is a compound of the amount of turns per week and the amount of activation, is therefore: 0.7 turns twice a week.

This information is correct but too mathematical to be given to the patient.

So in practice – as always – things are a bit different. Over the years, the reciprocal space closure was put into practice by rotating the screw:

**Twice a week, each time by one full rotation.**

Because a week has 7 days, it is acceptable to alter between turning the bolt every 3 and 4 days.

Explanation - concerning 1 full rotation:
- For one, the patient's instruction for "a full rotation" is significantly easier to conduct. (A practical aspect not to be underestimated!)
- On the other hand, from tooth movement resulting periodontal remodelling processes, such as the breaking up of the lamina cribrosa, allow us to assume a widening of the periodontal gap. A minor enlargement of the activation amount is thus permissible.
- Lastly, due to the tension wire's elasticity and free play within the Hycon- auxiliary tube-connection, the "net activation" amount per rotation always lies slightly under the bolt's measured pitch value.

Among patients with a normal tissue response, the above mentioned activation profile has established itself over the years as the standard procedure, with no clinical or radiological abnormalities worth mentioning.

Additional findings from the practice:

The distance that a tooth can be moved in a month is by far more than one millimetre. – Prerequisite for this is, of course, that the necessary alteration processes of the tissue, essential for tooth movement, have been completed.
(Exceptions where activation occured more than twice a week showed no abnormalities from healthy periodontal-ratios).

In my opinion, good orthodontics should not be geared towards “high speed orthodontics”; I will therefore not delve into the topic more.
I will only say this: “If there were such a thing as a “blue ribbon of orthodontic tooth movement”, the Hycon would have a fair chance of winning this ill-fated trophy.”

**Luminal narrowing vs. blood flow**

**Definition of the activation distance**

The possibility of adjusting the Hycon precisely, individually and defined, is of crucial physiological relevance. This becomes particularly clear when looking at what occurs with the periodontal gap’s lumen during the activation:
- We continue to look at the model of reciprocal space closure –
Assuming a periodontal gap width of 0.010” and one rotation per activation, the gap can (arithmetically) maximally be compressed by 0.007” (1/2 PB) on either side. Each side, therefore, remains with a “residual periodontal gap” of 0.003”.
This means the gap has only been narrowed down by 70%.

Because 30% of residual lumen is needed to ensure an adequate blood flow to the periodontal tissue, the prerequisites for tissue remodelling remain given. Owing to this, it is mandatory that under normal circumstances with each activation the Hycon should never be entirely rotated more than once!

For the one-sided space closure, where teeth on one side of the space are meant to stay stationary, the activation distance correspondingly only amounts to half. Further on, the screw should be activated twice a week, but(!) only by half the distance; so only by ½ a rotation (180°).
It remains up to the reader to imagine having the teeth moved as precisely and predictable by means of any elastic element of force.

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Day-to-day clinical aspects
…after Maths follows Biology, Pathology and Bio-Mechanics

In the previous section, I predominantly spoke about the mechanical aspects showing that the activation process follows precise and non arbitrary criteria. These examples were deliberately based on a standard situation: a healthy patient, “normal” response, unproblematic space closure.

Now cases relating to everyday situations will be discussed. In doing so, the goal is to supply as much information as possible, in order to raise the orthodontists' confidence in usage as well as decision-making.
So far, it has not been taken into consideration that the large range of clinical factors/variables, including pathological manifestations, naturally requires a flexible and individual approach – as with space closure.

Factors playing an additional role in our primarily mechanic space closure, show to consist of a large spectrum:
It evidently makes a difference whether a space is closed by a two-sided (reciprocal) closure or under the process of maximum anchorage. The spaces to be closed can be of differing sizes or a dental shift of the midline could occur.

Compared to adolescents, adults show a slower tissue response, the mineral metabolism (calcium turnover) is for instance delayed. Applying as a result, the treatment of adults is more difficult and especially the therapeutic possibilities are restricted.
Aspect: metabolic problem

Because an adult’s reduced metabolic capacity lies at the root of the problem – next to the aging of teeth and periodontal structures having already taken place – the Hycon can help to widen the therapeutic possibilities. In order to allow the organism to respond instead of being overwhelmed the orthodontist adjusts the activation profile to the patient’s reduced and delayed metabolism. So the tissue’s over-acidification can for instance be prevented (see alkaline phosphatase)
Of course everything works more slowly – but it works. Here, an increased force would be counterproductive.

An adequate profile could for instance involve a reduced activation distance (1/2 rotation) and/or prolonged periodical intervals between individual activations. Now and then, not activating for a week for instance is also a possibility as it gives the tissue time to recuperate.

Many users confirm the advantages the Hycon technique has when dealing with adult treatment. The general opinion seems to be that without the use of the Hycon, space closure would not have been achievable. (See also, the graphic illustration of the activation profile)

The periodontal involved dentition adds to the issue of adult treatment. It is well known, that a periodontal depletion is generally accompanied by inflammatory processes and that every orthodontic treatment should be preceded by a systematic periodontal treatment. Hereby, it is also suggestive to thoroughly remove granulation tissue, as it can react on the orthodontic irritant by expanding, repress periodontal tissue and cause relapse following the treatment’s completion, due to its elastic and spongy consistency.

Additionally, the periodontaly involved tooth shows its own biomechanical characteristic: Dependent on the periodontal problem’s extent, the root’s surface section that is connected to the alveolus via Sharpey’s fibres is reduced. On the one hand, in accordance with the formula: pressure = force per area, the lack of marginal attachment results in the pressure having a potential, of being substantially higher when using an equal force. Adding to this on the other hand, by the periodontal reduction resulting in fewer available functioning sections of root the tilting lever expands. Consequently, the centre of resistance has also shifted towards the apex. It hereby becomes all the more difficult to implement a bodily movement of teeth. The tilting movement, with its cervical and apical load peak, can provoke an additional strain to the already weakened tooth.

Here too, the Hycon’s proficiency simplifies the therapy considerably, particularly by allowing the tooth to largely be moved bodily along the strong arch, disregarding friction making the movement in tiny steps calculable – or possible in the first place. Coming close to bodily tooth movement the rate of tissue turnover, with all it positive consequences, is at a minimum.

The response of the tissue itself can vary greatly. Accountable for this, can be a local dysfunction of the tooth or in its direct surroundings (e.g. an untypical reaction in the area of tooth aplasia), as well as a general disorder involving the bone-metabolism (diabetes). In addition, the metabolism of the periodontium can also be influenced by medication (e.g. cortisone).

Considering all these aspects when treating a patient or when performing a space closure primarily comes down to the orthodontist’s assessment and competence. And it’s hard or even impossible for the orthodontist to perform his task therapeutically when using a space closure mechanism without the adequate mechanical features.

Providing the orthodontist with an activation profile for every above mentioned individual variation of response, would be going too far and be ultimately useless. It is enough to know, that tissue partly only has reduced metabolic/alteration capacities to its disposal and consequently alteration processes are appropriately slowed down. Additionally, occasional periods of regeneration – i.e. for tissue activity to decrease – are very beneficial for a “normalisation of the metabolism”. (Compare with the “logistical problem”!)
On account of the large knowledge on patient’s individual clinical/medical requirements, an orthodontist must determine the appropriate activation profile. Among the activation distance and rate (times of activations), a large number of “variants on tuning” is available to him.

In the following, the wide range of possibilities should be exemplified through loading diagrams of some of the activation profiles. (Two of these examples are extreme to demonstrate the vast range of the variations of activation)

**Explanation of Graphs:**

The **horizontal axis** represents the time: time scale = 1 day

**Data:** progression of time and day on which activation took place — thus the frequency of activation.

The **vertical axis** represents the amount of activation: activation scale = ½ rotation per rotation 0.012” were determined as the “net activation stretch”

**Data:** the magnitude of individual activations and as a summarization, the entire distance being covered.

From the time-distance ratio the space closures, respectively the activation profiles, efficiency can be calculated.

The **horizontal sections (green)** represent the time intervals, available for tissue alteration (response period), following the act of activation by turning the bolt.

This period can, if extended, additionally function as a regeneration phase (light yellow).

The **vertical sections (red)** point out when activation took place and the amount of activation (activation distance).

Please note: all measurements and calculations have been rounded.

**Example A**

Activation profile: standard
Activation interval: 3.5 days
Activation amount: approx. 0.012” (1 turn)
Note: An activation interval of 3.5 days provides enough time for alteration and regeneration. Space closure characteristic: reciprocal (two-sided), no anchorage.
Indication: healthy periodontal status, reciprocal space closure, ordinary response (solid metabolism).
Results:

Total amount of space closure: 0.108" / 30 days
Average movement (reciprocal): 0.054" / 30 days
Average daily movement (calculated): 0.0018" mm

Example B

Activation profile: standard
Activation interval: 3.5 days
Activation amount: approx. 0.006" (1/2 a turn)
Note: See Example A
Space closure characteristic: one-sided, maximum anchorage.
Indication: healthy periodontal status, one-sided space closure, ordinary response (solid metabolism).
Results:
Total amount of space closure: 0.054" / 30 days
Average movement (max. anchorage): 0.054" / 30 days
Average daily movement (calculated): 0.0018"

Example C
Activation profile: high efficiency
Activation interval: 2 days
Activation amount: approx. 0.012" (1 turn)
Note: An activation interval of 2 days provides little time for regeneration.
Space closure characteristic: reciprocal, no anchorage
Indication: good response, healthy periodontal status, adolescent organism, good alveolus condition – time issue.
Caution: Possibility of overstraining the tissue due to the very short or even non-existent regeneration period. Hence, the usage should be limited and the indication narrowed.
Results:

Total amount of space closure: 0.18" / 30 days
Average movement (reciprocal): 0.09" / 30 days
Average daily movement (calculated): 0.003"
Example D

Activation profile: very slow, tissue-protecting
Activation interval: 6 days
Activation amount: approx. 0.006” (1/2 a turn)
Additional regeneration period of 4 days (18th to 22nd day)
Note: The prolonged activation interval takes the slower tissue alteration, the delayed reaction and the prolonged regeneration period into consideration.
Space closure characteristic: balanced, no anchorage
Indication: periodontal weakened periodontium, adverse response

Results:
Total amount space closure: $0.030” / 30 days$
Average movement (reciprocal): $0.015” / 30 days$
Average daily movement (calculated): $0.0005”$

Additional consideration:
I could imagine that a stimulus that is too faint can become subliminal. It would not give a clear and precise message of movement but would be perceived as a “diffuse irritation”. This, potentially, may result in a degeneration process, rather than the desired movement. Pay attention that the message is strong enough otherwise it can be “misinterpreted”. The consideration follows in relation to “under-dosing” the activation profile.

To the regeneration phase:
It can/should be applied to every activation profile when there is any indication of overexertion of the tissue metabolism. Thus, with a large gap and rapid closure, it is noticeable that after some time of rapid movement a distinct slowdown can be detected. Variations on this: tilted teeth despite a strong arch, a heightened sensibility when re-activating the Hycon. In this case, it is advisable to implement a regeneration period and if necessary slightly turn back the screw.
It is of utmost importance that whatever length of activation distance is chosen, sufficient blood supply must be warranted – remember residual lumen of 30%! 
Leading character and collaborator: The patient

The most practical way of selecting an activation profile, is by matching the patient’s own perception with the appropriate profile, namely because he is able to feel the slightest pressure and then also locate it. He can distinguish between pressure and pain. And it is the patient that activates the Hycon.

It has been proved successful to instruct him in the following way: First, he is informed on how often per week the Hycon is to be readjusted – here the orthodontist must decide by taking the above mentioned aspects into consideration.

Then, and this is the most important part of the activation, he must be instructed on how the Hycon screw is to be turned, - especially in which direction.

The procedure consists of two steps:

1) The pre-activation: The patient is asked to carefully turn the screw clockwise (to the right) until he begins to feel a slight pressure. It is at this point that the connecting wire, between the Hycon and the tooth/group of teeth on the other side of the space, is straightened.

2) Actual Activation: Then follows the actual activation. The patient now continues turning the screw appropriate to the instructions given – naturally in the same direction.

The orthodontist, who is familiar with the relationship between activation stretch and rotation, and clear on the clinical aspects as well as his desired results on the treatment, decides to what extent activation occurs.

A very helpful and crucial “clinical feature”: The Hycon operates absolutely painlessly when activation takes place within the physiological scope.

The patient should, by all means, be informed of this. It represents optimum comfort for the patient – and why should he not know what quality of treatment is being offered to him? Moreover is it an indication to the patient that activation has been performed correctly. In case the patient finds the pressure to be too high, the screw can simply be turned back slightly.

For me, at first, the idea of allowing a patient to turn the screw himself needed some getting use to. But the activation itself is less complicated than employing headgear. When activating in front of a mirror, it is however to be noted, to pay attention to the direction rotation takes place in (“mirror inverted”!).

Adding to this, Adenta has developed the special safety screw driver, to largely preclude injuries.

Our experiences have shown that patients, after having been informed properly, could in virtually all cases activate the Hycon correctly and reliably. Because the space closure usually follows at the end of the treatment, it is psychologically beneficial to inform the patient that the point at which the appliance is removed is dependant on his correct activation. Some sharp patient may now think: the more I turn the screw, the quicker I am rid if it. That is why I have always warned never to turn too far because the tissue “jams” and the final part of treatment is delayed.
**HYCON ACTIVATION GUIDELINES**

**ANCHORAGE SITUATION OF CASE PRESENTED**

<table>
<thead>
<tr>
<th>CLINICAL CRITERIA</th>
<th>• RECIPROCAL SPACE CLOSURE</th>
<th>• RECIPROCAL SPACE CLOSURE</th>
<th>• SPACE CLOSURE: ONE SIDE STATIONARY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• ANCHORAGE DEMAND: NONE</td>
<td>• ANCHORAGE DEMAND: LITTLE *</td>
<td>• ANCHORAGE DEMAND: MAXIMUM *</td>
</tr>
<tr>
<td></td>
<td>( EQUAL BLOCKS ADJACENT TO SPACE )</td>
<td>( DIFFERENT BLOCKS ADJACENT TO SPACE )</td>
<td>( ANCHOR UNIT: WEAK )</td>
</tr>
<tr>
<td>• ADOLESCENT PATIENT</td>
<td>2 full turns per week</td>
<td>2 full turns per week</td>
<td>2 x 1/2 turn per week</td>
</tr>
<tr>
<td>• OPTIMAL TISSUE RESPONSE</td>
<td>[3 full turns per week]</td>
<td></td>
<td>[3 x 1/2 turn per week]</td>
</tr>
<tr>
<td>• NO PERIODONTOSIS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• VITAL ADULT PATIENT</td>
<td>2 full turns per week</td>
<td>2 full turns per week</td>
<td>2 x 1/2 turn per week</td>
</tr>
<tr>
<td>• NORMAL TISSUE RESPONSE</td>
<td>[3 x 1/2 turn per week]</td>
<td>[3 x 1/2 turn per week]</td>
<td>[1 full turn per week]</td>
</tr>
<tr>
<td>• NO/LITTLE PERIODONTAL ISSUE</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• ADULT PATIENT</td>
<td>2 x 1/2 turn per week</td>
<td>2 x 1/2 turn per week</td>
<td>1 x 1/2 turn per week</td>
</tr>
<tr>
<td>• REDUCED TISSUE RESPONSE **</td>
<td></td>
<td></td>
<td>[2 x 1/2 turn per week]</td>
</tr>
<tr>
<td>• REDUCED MARGINAL BONE RIDGE</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[ ] indicates an alternative possibility of activation - based on individual findings
- additional measures of anchorage are necessary (intermaxillary elastics, HG)
** indicates additional prolonged interval between activation should be given occasionally (due to tissue response)

Important instruction to be given to the patient.

**Note:** Generally two step activation is required.

**Preactivation:** To reduce the slack of the connection wire the patient should turn the screw clockwise until they feel a slight tension.

**Actual activation:** Only turn the screw in accordance with the instructions given by the orthodontist. (According to the above directions)

**IMPORTANT - THE HYCON FUNCTIONS PAINLESSLY**

Disclaimer: Please be advised this activation guideline cannot take the place of the orthodontist expertise and visual inspection.
At the end of the journey comes the task of parking – or:
The steering of the space closure

Conducting the space closure with the help of the Hycon has another practical advantage. This is shown through the aspects of anchorage:

It exists in that the pressure acting on teeth involved in the space closure can be regulated – distinguishably and precisely.

The initially balanced active pressure, acting on the “anchored side” as well, is now capable of being reduced, so that the alteration activity there is virtually zero.

Generally, this is important where maximum anchorage is necessary, as for instance with the retraction of the upper-frontal-segment when laterally Class 1 relations already exist.

A situation with a one-sided space closure or when the anchored side, meant to remain static, is clearly the weaker one, and is generally harder to treat.
How is this going to look in practice, however?

For a better grasp on the processes taking place one must take into consideration that, strictly speaking, three different mechanical elements are involved in the process of space closure, similar to the one involving “sliding mechanics”.

Here, in the strictest sense of the word, the “division of powers” principle takes effect:
1) The arch: It is passive, straight and dimensionally rigid.
   It effectively represents the “rail”.
2) The Hycon: It delivers the force to overcome friction and move the tooth.
   It is comparable to the “motor”.
3) The anchorage element (elastics, headgear, etc.): It controls the direction of movement.
   It is the “steering unit”.

By being able to co-ordinate these three elements, so that none of their effects exceeds or hinders the others’, we acquire the ability for a precise and controlled space closure.

For the moment, this is of course only a model to illustrate the importance of a precise and adjustable “element of force”. But it is of practical relevance. To transpose it into a real treatment may seem complicated.

Once again, the patient assists us!

As already mentioned above, he is able to respond highly sensitively to occurrences within his teeth’s periodontal structures.

A helpful example for the steerage shall be demonstrated now by the space closure procedure in the lower jaw. (It has been schematized for a better understanding)

A real and similar case is explained in “space closure report 2”.

Initial situation: Merely by moving the molar mesially, the gap of a single missing second premolar in the 4th quadrant shall be closed. Other than that, a Class-I occlusion with no midline shift is present. From it results a maximal anchorage demand for the lower front and the teeth 43/44.
An additional task exists in keeping the symmetry of the mandibular arch.

**Treatment status**: A fixed appliance is installed, the arch’s strength amounting to (in an ideal situation) .021”x.025” (with a .022” technique). The arches are shaped harmoniously, space 45 is open, and the teeth are aligned correctly.

(To not disrupt the harmony, the arch was not bent on the right lower jaw in the phase of levelling, so as to allow the initially mesio-lingual tilted 46 to be set upright.) Now the Hycon is inserted at 46 and connected to 43 by a ligature wire. A figure 8 ligature-wire connects all teeth from 36 to 44 in the lower jaw with each other! The arches are distally bent.

**Activation profile**: ½ a turn twice a week (c.f. ‘Example B’)

Initially, the Hycon generates the same amount of pressure, and resultant in tissue reaction, on either side of the space. Consequently, the patient feels some pressure on both sides.

To assure that the stimulus for tissue reaction in the “frontal mandibular segment” stays beyond the threshold of tooth movement, the “anchorage element” must be inserted – the steering unit.

In our case, it is – logically – a Class II elastic from 13 to 46.

Once the patient has mounted the intermaxillary elastic, he will notice an increase in pressure on 46 and a decrease in the “frontal mandibular segment”, representing the “anchorage unit”.

If pressure is still felt there the Hycon is “deactivated” to avoid an alteration stimulus acting on the “frontal segment”. This means, the screw is turned backwards (anti-clockwise) very slowly until the patient feels no pressure whatsoever on the “frontal mandibular segment”, but rather only on the molars.

When choosing elastics, here too, size and force must be attuned to the individual patient.

Thus valid as a normal case scenario:

*For the distance between upper canine and lower 2nd premolar: red (1/4”) heavy (6.5oz)*

*For the distance between upper canine and lower 1st molar: blue (5/16”) heavy (6.5oz)*

- If needed Class II elastics from 13 to 44 could additionally be mounted over night.

The intended coordination of the “three elements” has been completed.

The appropriately informed patient is now capable of activating the Hycon and carrying out the anchorage steerage on his own.

This was a rather rare but simple case for explaining the principle of anchorage steerage. One should find no problem mastering other “constellations” when it comes to the analogous ending.

Whilst reading these lines, it may at first seem laborious steering the anchorage in this way. The practical implementation takes only a fraction of the instructions and in return, one has the option of controlling tooth movement.

**Space Closure Report 2: An easy case- if you take your time.**

**Case**: The 15 year old patient (female) displayed a Class I occlusion. Tooth 36 had been extracted at the age of twelve. 35 has drifted disto-lingually and 37 has grown mesio-lingually into the free space. A slight distal shift of the 3rd quadrant could be observed- as well as a deficiancy in vertical hight. The x-ray showed a well developed 38.
**Aspects of treatment:** The failure to take adequate measures after the extraction of 36 had as a consequence the “collapse” of the 3rd quadrant. The intention was to “restore” the dentition, trying to reach a good functional result without the need of prosthetics.

The treatment was similar to the one being described above.

**Fig. 1a /1b:** Situation in the lower arch before treatment./ Close up 3rd quadrant.

**Initial treatment:** After transversal developing of the lower arch, uprighting and mesialising of 35, uprighting and distalising of 37, with a .021”x.025” stainless steel archwire installed and with a correct intercuspidation archived, the teeth were ready for space closure. All teeth from
47 over to 35 were connected by a figure 8 ligature wire. The archwire was bent back distal of 37 and 47. The upper jaw had been treated up to a .019"x.02" arch as well to fit to the lower arch and to serve as a support for anchorage measures.

**Fig. 2a /2b:** Situation after inserting the Hycon./ Close up 3rd quadrant.
The patient was ordered to turn the screw 2 x 1/2 a turn per week and to wear class II elastics blue heavy from 23 to 37 day and night. (This measure was taken as I didn’t have confidence in the strength of the anchor unit 33,34,35).

**Fig. 3a /3b:** Space closure completed./ Close up 3rd quadrant.

The space was closed within 7 months, the anchorage measures had been fully sufficient. The next step was to wait for 38.

**Steerage of anchorage**

**The principle difference**

Following activation, the space closure mechanism, working under the principle of elasticity, generates a constant tension. As a result, a permanent pressure is present, advancing the closure from both sides of the space. This occurs two-sidedly, and in relation to the extent of stretching, over a considerable distance - when considering the small dimensions that we are dealing within the realm of the periodontal-gap. Only when appropriately strong anchorage forces, equal to at least the elastic space closure’s tensions, are operating, can the steerage of anchorage take place. In case maximal anchorage is necessary, there is a high risk of loss of anchorage, due to the fact that as soon as intermaxillary elastics or headgear are not worn properly the two-sided pressure comes into action – even going against the direction of anchorage.

As already mentioned, by activating the Hycon the size of the space is reduced by a defined and limited distance (0.006") - 1/2 turn. Once this has happened, the entire “Hycon-tooth-braces-unit” turns passive and rigid once again. What happens in the alveole during this? The roots “hang” freely in the fibres of the periodontal ligament (PDL) (Scharpey’s fibres etc.), whereby the whole system tends to fall into a position in which the pressure produced is distributed equally.

In terms of the anchorage, this means the entire “Hycon-tooth-braces-unit”, being rigid, must be shifted. The force needed for this, must merely be measured so as to equate the tension generated in the periodontal ligament through the adjustment of the Hycon. Different to the elastic mechanics, due to the short activation distance only a slight tension has emerged. Consequently, only appropriately minor forces are necessary for the steering of the anchorage.

Provided a normal situation, it should therefore be adequate to conduct the anchorage only with intermaxillary elastics. From this it follows, that the employment of headgear and the like become widely redundant. If used at all, then only when sleeping.

In this context it should be mentioned, that it is generally sensible to complete the activation of the Hycon directly before going to sleep. The steering effect of the anchorage measures overlaps with the space closure impetus and we have a relatively long effective period. It goes without saying that the patient is bothered less when sleeping.
Trouble Shooting – or:
What is to be done, if it is not going as planned?

It is quite possible, that when using the Hycon repairs and corrective measures may be necessary. This may be pesky and annoying, but can nonetheless occur, considering that even the Hycon with its component parts, is exposed to the patient’s regular deferential handling.

When using a .012” wire it can occasionally snap. That is why the .014” wire is often favorable. It is slightly harder to install, but in return also stable in shape.

If overly exposed to masticatory forces, the holding-pin may buckle slightly. It can, however, easily be bent back into position.

A fatigue break may arise where the holding pin and screw nut cross, however, this occurs relatively rarely and in such cases the firm Adenta accommodates well for it.

It is recommended to use the Hycon only once to ensure a trouble-free performance.

Besides from these “appearances”, I am more interested in addressing possible difficulties during treatment:

Technically, where activated properly, corrective measure should not be necessary – yet still; a patient’s “over-eagerness” may lead to the screw being turned too quickly. But who knows, maybe the arch was not strong enough?

Should there be any risks of the procedure taking an undesired course the following findings tend to be indications for it:

The gap may have been narrowed significantly, but:
- The frontal segment is positioned more steeply
- The chewing plane is sagging
- The teeth are tilted towards the gap.
- A change in occlusion is also noticeable.

All these emergences can be found individually or together, and in more or less pronounced forms.
Thus it is recommended to check for these signs during routine inspections.

For our “standard example” of the problem, I am assuming all of the above-mentioned features being present, representing a worst-case scenario and rather unlikely to occur. In a similar case, the patient had not kept in mind the number of times the screw was to be turned. As a result, he was turning the screw daily by half a turn. Also, a .017”x.025” arch was applied by a .022” technique:

Planned originally, was to close the spaces of aplasia at 35 and 45 by mesializing the molars. Once the patient returned to the practice, the spaces had been considerably reduced, the teeth appropriately tilted, the lower front set upright, overbite and over jet had grown, with the chewing plane in the 3\textsuperscript{rd} and 4\textsuperscript{th} quadrant sagging significantly.

The intention of the measures taken afterwards was to reverse everything.

Hence, the Hycon screw and the connecting wire were removed, while the nut remained in place.
The lower arch was examined. Due to a slight deformation and to spare the tissue, a new arch of the same strength was installed as a replacement. In case the deformation of the old arch wire was too severe, one should not hesitate to insert a 0.16” x 0.22” or a Niti of the old size, this benefits the tissue.

To ensure that when “releveling” the gaps initially re-widen again as well as the molars distally setting upright, the arch was left open distally (and protruding). This measure is also necessary for the correction of the lower front tooth position.

Additionally, the patient was instructed to hang Class II elastics (red/heavy) from upper 3rd onto lower 4th. Only once the arch had acted and leveling was satisfactory again, was the fully slot-filling “final arch” inserted. It is crucial to keep an eye on the anchorage situation and occlusion during “releveling” and to allow the appropriate intermaxillary elastics to operate.

Once all the changes brought about by the inaccurate activation have been corrected, only then can measures for the space closure be taken again.

Experience has shown that if the activation profile is not too “aggressive” and the process is regularly examined to recognize potential issues early on, it is practically impossible for the problem discussed above to arise.

Usually, a reaction starting to run off course is quickly recognized. Mostly it is then enough to discontinue turning for approximately 4 weeks, merely allowing the intermaxillary elastics or the like to take over the role as steering unit.

**Space Closure Report 3:**

**Case:** A 14 year old male with Class I occlusion right and Class III tendency left. Additional to a surplus of space in both jaws (front) he revealed a severe dento-alveolar midline shift to the right in the lower front. The overjet was barely sufficient.

**State of treatment:** Leveling and aligning is completed, in each jaw a straight .021”x.025” stainless steel archwire (.022” slot system) is installed. Teeth are grouped in blocks, spaces distal the upper lateral incisors and between 32/33.

**The space closure:** Due to the very small overjet and the midline shift it was necessary to begin with the space closure in the lower jaw, while the spaces in the upper jaw were kept open.
**Fig. 1:** The Hycon is inserted in the lower jaw. The patient was told to turn the Hycon 2x 1/2 turn per week. Additionally he had to wear Class III elastics blue heavy from 26 to 33 during the nighttime.

**Fig. 2:** State of treatment after the Hycon has worked 3/4 of its range. The Hycon is reactivated, activation order/ intermax. as before.

**Fig. 3a:** The Hycon has worked another 3/4 of its range. The space in the the lower jaw has become significantly smaller, the overjet and the midline shift are improved. Time has come also to install the Hycons in the upper jaw. All the three Hycons have to be activated simultaneously 2x 1/2 a turn per week, class III elastics to be continued.

**Fig. 3b, 3c:** Occlusal view of same state.

**Fig. 4:** State of treatment about four weeks later.

**Fig. 5a/ 5b:** After another 3/4 range action of the Hycon, space closure is carried out. The midline is correct. The bolts of the Hycon are removed. Now the occlusion has to be adjusted, finishing has to be done.
Although three spaces have been closed simultaneously, there was no problem to keep track of the treatment.

Comment: The reader will have noticed that the Hycons have worked over a longer range than was the amount of space. Imagine: Within the treatment of a case showing a (severe) dento-alveolar Class II, we have decided not to extract in the upper jaw, i.e. treatment is planed by distalizing the teeth in the upper jaw.

In the state of treatment when the upper lateral teeth are distalized the following situation can be observed:

- the lateral teeth are in Class I occlusion
- the lower jaw is correctly shaped and aligned
- levelling is done, there are no spaces in the lower jaw
- the upper lateral teeth are distalized
- the upper jaw is correctly aligned but there are spaces located distally to the second incisors/ or distally to the canines
- "consequently' the overjet is increased

In both jaws heavy archwires are installed. The situation is given to insert Hycons in the upper mandible(?) in order to retract the upper front. (max. anchorage demand)

Jet an additional observation can be made:
A transversal discrepancy, easy to be recognized, 'has devlopeed'- both jaws don't fit.
This phenomenon has not been there at the begining of treatment.
It shows that the lateral part of the upper jaw is (much) broader than the lower one.
This observation is absolutely normal within this state of treatment, because due to the spaces in the upper jaw we really do have a -temporarily- larger upper jaw. Its length is longer.
Due to the fact that this surplus of length is located in the 'canine region' it must have transversal relevance.
Although it sometimes looks a little strange it would not make sense to correct this findings by shaping/bending the archwire accordingly.
Simultaneously with space-closing by the Hycon we can observe that not only the overjet is reduced to normal but that the shape of both dental arches ends up in fill harmony.
This phenomenon/spectacle/performance for me always is a pleasure to watch.

The lesson is clear…

I have tried to clarify the basic difference between “elastic forces” and “screw mechanisms”. Since the activation characteristics of the Hycon allow the orthodontists’ to follow criteria which are based on the results of physiological research and on clinical findings, I believe, this difference is not only an academic one. It is also highly relevant for orthodontic treatment. The harder and more complex the tooth movement or space closure problem is, the more significance it carries.

Due to its mechanical features and precise adjustability, the Hycon facilitates the movement of the tooth appropriate to the physiological demand - even monitoring anchorage becomes easier.
This makes it possible for the orthodontist to extend his therapeutic limits.

Beyond the practical aspects in treatment, it can even have implications up until the planning of the treatment. 
Or, as K. Marx didn’t say: The technical possibility influences the “design”.

…but there was one last question

Although it ought to, in relation to its relevance, already have been resolved, one last question remains as this essay draws to an end.

“How much force does the Hycon exert?”

After there being such controversies over different information, opinions, and inquiries into the selection, we wanted to know for sure:

The research and development department of Adenta clamped a Hycon 22 with a .012” tension wire into a tension testing unit. The mechanism was continually run with increasing force until the Hycon tension wire combination “complied”.

We ourselves were eager about where the “weak point” could be situated. Would the tension wire snap, the holding-pin break out from the nut or the threads possibly slip out - and at what force would this occur?

I do not believe that under any psychological aspects it could be counter productive to announce that value, as a friend and colleague objected. I, however, assume that no one (who has read this report) will turn the screw to the point of snapping. Moreover, at this point his patient is likely to have fled from his chair already.

So, before it becomes too absurd: The tension wire snapped.

The display of the measurement appliance indicated eight-thousand-six-hundred-seventy centi-newton. Incase your patient should ask you can tell him 311.8ozs.

It is reassuring to know that this force is enough to overcome every possible friction emerging within orthodontic therapy.
It is important to know, that a 360 degree rotation is equivalent to a 0.014” space closure.
The “actual Hycons” - 2011 -

Fig 1: The “Hycon Tube”: direct develop line from the “Hybrid Screw” - to be used with double buccal tube.

Fig 2: The “Hycon ClipON”: designed with a self-ligating locking clip - to be attached directly to the arch-wire. Recommended when a double buccal tube is not available.

The Hycon moves differently join the Hycon movement.

“No comment”