

# One hundred consecutive Invisalign cases analysed

Paul Humber examines the results of his first 100 Invisalign cases

Invisalign is an orthodontic system where we can design treatment plans on the computer using Align Technology's ClinCheck software, while simultaneously drawing on Invisalign's experience of similar cases. Invisalign then create a series of clear 'aligners' for the patient to wear which will straighten their teeth.

I first trained to use the technique in 2003, prompted by the fact that our practice is near two large US Air Force bases, and our American patients kept asking for Invisalign, which was already a well-established technique in the States at that time.

Now that my first 100 Invisalign cases are in retention, it made sense for me to quantify the experience of that 100, to analyse the results, and reflect upon what I learnt in the process. The 100 consecutive cases detailed here deal with active treatment from the years 2003 to 2006.

## Headline data

- 4% dropped out
- 6% had one tooth or more, which didn't complete its predicted movements
- 0% had new caries
- 4% had a restoration replaced
- 4% experienced temporary gingival bleeding
- 1% experienced increased periodontal pocketing
- 6% had an improved periodontal or gingival condition
- 16% were previous orthodontic relapse cases
- 1% said they wouldn't have done it again
- Average treatment time: 13.5 months (first impression to retainer)
- 46% took less than a year:
- 28% recommended a friend who then successfully had Invisalign
- Average clinical hours per case: approximately eight hours

## Caries and orthodontics

The caries rate with Invisalign (0%) is so low that I was initially dubious of my own findings, and as such I embarked upon a supple-

mentary study to check the data, for example asking patients whether they had had any restorative work without telling us. We are currently arranging to run a specific research project looking at 100 consecutive Invisalign patients to check their caries rates in conjunction with a University department.

The subject is of obvious interest given that fixed appliances are thought to cause demineralisation in a massive 50% of patients (Gorelick et al 1982).

At this stage I would speculate that our excellent results had several causes.

Firstly, Invisalign's protocol is that the teeth should be restored and sound prior to treatment. Secondly, Invisalign tends to be faster than fixed appliances and can be removed to facilitate oral hygiene. This may not be a significant factor, given that demineralisation with fixed appliances frequently occurs in the very first month of wear (O'Reilly et al 1987).

Thirdly, the aligners have to be removed for eating, so patients tend to become aware of their 'snacking' habits and have reported that they tend to forego a lot of mid morning and mid afternoon snacks as a result. In other words, their diet improves during the treatment.

Finally, because Invisalign was new in the UK at the time, the patients themselves tended to be what is known as 'Early Adopters': they were well educated, thoughtful people who put a lot of effort into their lives. They frequently had no previous restorations or caries whatever, good diets, had oral hygiene that was well above average, and were very good at taking instructions on board. It's only a guess, but I would suspect that caries would be a little more prevalent as Invisalign catches on more amongst the UK public, but still dramatically below the rates we see with fixed appliances. The use of Invisalign in the UK approximately doubles with each year, so it would be inevitable that it starts being used by more patients with less than perfect oral hygiene habits.



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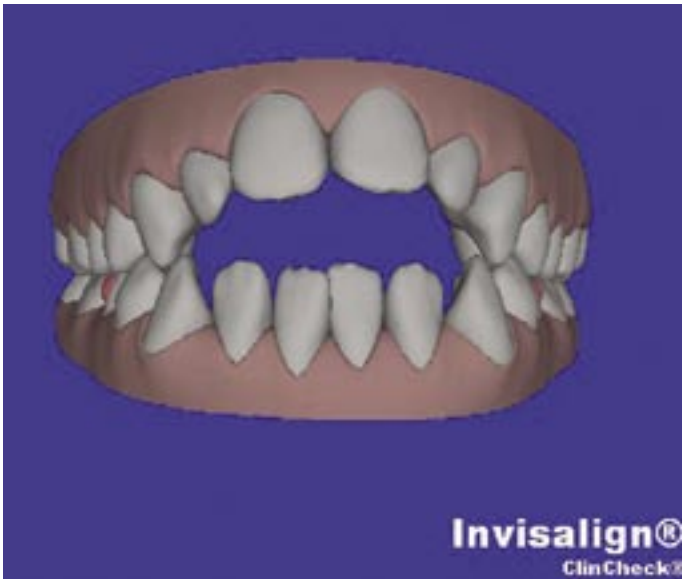


Figure 1: An anterior open bite case on ClinCheck

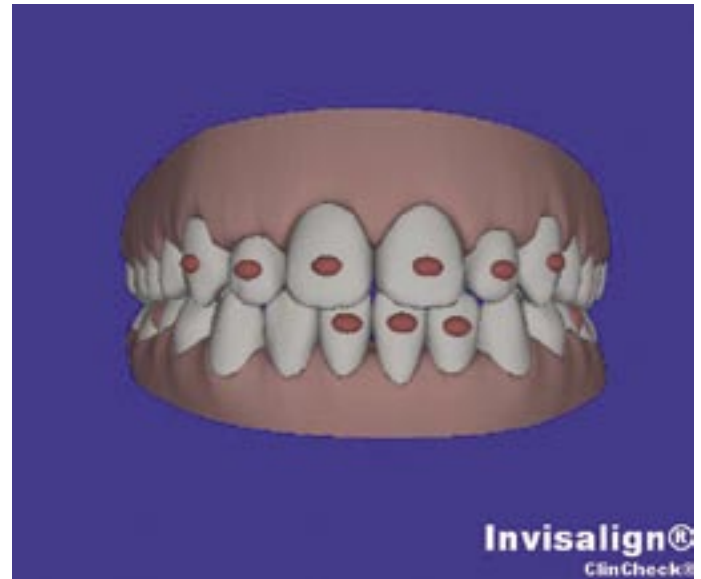


Figure 2: An anterior open bite case on ClinCheck: overcorrected



Figure 3: Case A pre-op



Figure 4: Case A post-op

## Periodontal concerns

Previous research has indicated that fixed appliances cause temporary gingival inflammation in almost all patients (Travess et al 2004) but that Invisalign appears to allow the gingiva to remain the same or improve (Taylor et al 2003, Turatti et al 2006). My own observations supported this view.

## Pleasant surprises

On the very first training course I attended for Invisalign, it was suggested that the potential weaknesses of the technique are when we attempt to:

a) correct rotations of more than 30 degrees

b) need extrusions of more than 2mm

c) attempt translation of more than 3mm.

Reviewing my first 100 cases I discovered that if I discounted movement that was achieved by tipping teeth, there was no instance of a tooth that had needed a true translation of more than 3mm. There were, however, plenty of instances of large rotations and extrusions. I would proceed in these instances, but with caution and with a need to be particularly careful and vigilant during the treatment.

As if to test the system to destruction I had four patients who presented with large anterior open bites. These were women who

had managed to suck their thumbs or fingers well into their twenties and who were adamant that they did not want fixed appliances until they had at least explored the option of Invisalign. At the ClinCheck stage we 'overcorrected' the overbites, to compensate for the known high relapse rate (Lopez-Gavito et al 1985). I chose a plan that made the upper incisors 1mm longer than would be planned using the LARS criteria (Ahmad 2005) where the upper incisal length is considered in relation to lip length. The planning on the ClinCheck is shown on Figures 1 and 2. All these cases went gratifyingly well.

In a similar vein, we had large numbers



Figure 5: Case B pre-op



Figure 6: Case B post-op



Figure 7: Actress Heather Graham

of patients whose teeth were rotated by 60 degrees or more; in this group we had one tooth that didn't rotate as well as hoped (see below), but we were largely very pleased with the results, for example in the two cases shown in Figures 3 and 4 and Figures 5 and 6.

## Designer smiles

A number of the cases threw up an intriguing new phenomenon: 'designer smiles'. Female patients were arriving clutching magazine photographs of glamorous role models whose teeth they admired. Surprisingly, these tended to be either bold smiles, such as Kylie Minogue or atypical smiles such as actress Heather Graham (Figure 7). The example I show here is of the latter, where a Class 2 Div 2 patient explored the possibility of achieving a similar 'look' as Heather Graham, given the need for stability and a need for teeth to occlude (Figures 8-11). It's sometimes possible to do this sort of thing and sometimes it is ill-advised; but in either event, the ClinCheck software gives us a chance to mock up the possibilities and either demonstrate to the patient that it is a bad idea or, indeed, make it happen.

## Clear audit trails

Eight of my first 100 cases were people whose 'looks were their living' i.e actresses and models. They were attracted to Invisalign because fixed appliances would affect their looks in the short term, while Invisalign could be removed when working.

From my point of view there was a further advantage: the patients were able to look at the ClinCheck plan and 'sign off' the look that we were going for. This allowed both the patient and I a chance to sleep at night. One

example was of a (very) highly paid model who explained that part of her 'trademark look' were her two bold looking upper central incisors. She wanted the position of these teeth to stay largely the same, albeit a little 'tidied up', and we were able to show her the plan, reassure her that this would be the case. (Figures 12 and 13) and she was able to 'sign it off'.

## Drop outs

Interestingly, the one patient who said she wouldn't have done it 'again' did recommend two friends to have the treatment: she and I both felt she had convoluted occlusal problems that made her an atypical case.

Of the four patients who dropped out; two thought they would have the willpower to wear aligners, but in the event they didn't. One became pregnant and had such dreadful morning sickness that she gave up having anything in her mouth and then didn't restart. One dropped out for financial reasons.

## Failures

The treatment regime I utilised involves a computerised plan which then creates a first 'set' of aligners, and when they have been worn, I take stock and ask for a smaller number of aligners to 'fine tune' the result. My criterion for a failure, therefore, is whether at this second stage, we have still not got what we wanted.

One patient (1%) felt that the teeth hadn't moved as planned, but I felt it was a good clinical result. With two patients (2%) I felt at least one tooth hadn't moved enough, but the patients couldn't see what I meant and were happy. In 3% of cases, both the patient and I could see at least one tooth hadn't moved as originally planned. In terms of the teeth

concerned: there was a total of two teeth that needed extra rotation, and three teeth that would ideally have been moved an extra 0.5-1mm either labially or palatally. There were no residual problems with extrusions.

We treated a huge variety of cases with a huge spectrum of complexity, so I felt that the fact that only one patient 'wouldn't have done it again' is a very high success rate.

More importantly, we are now discovering that Invisalign cases are not apparently suffering root resorption, so we are getting a picture of teeth that would rather not move at all than suffer resorption, whereas fixed appliances tend to move teeth even when those forces will result in biological problems. This implies that we should accept the relatively small failure rate of Invisalign.

## Transferring cases

Another interesting discovery was that cases proved easy to transfer between clinicians across the world. The generation who have sought out Invisalign tend to be in their late twenties and single at the start of treatment. They are a generation who travel a lot and may follow their career abroad and back. As such, we were able to start cases in the UK and transfer them to clinicians abroad when the patient moved. Conversely, I have received two patients who started in the USA and transferred their computerised notes and details to us to continue their treatment. Invisalign by nature holds the patients records and treatment plan centrally and this can be released and moved by mutual consent. It would be very difficult to achieve the same ease of transfer for fixed appliance cases. The case shown here (Figures 14 and 15) is a patient who started in the USA in August 2005 and transferred to the UK the



Figure 8: Case C pre-op - front facial shot



Figure 9: Case C pre-op - right side shot



Figure 10: Case C post-op - right side shot



Figure 11: Case C post-op - left side shot

following summer with no loss of continuity or time lapse.

## Weight loss

One surprise was that our patients frequently reported that they were losing weight. Not surprisingly we didn't specifically ask the patients about their weight but a large number volunteered the information that they had lost 3-4 pounds. Presumably similar reasoning applies here as applied to the low caries rate; the aligners made patients aware of their snacking habits, and sometimes it unsettled their eating routine. Losing weight, is not always a desirable outcome, of course.

## Conclusions

Patient after patient have volunteered views along the lines of 'I can't believe anyone is still having train tracks.' The public have en-

thusiastically taken to the technique, enjoying the benefits of shorter treatment times, greater aesthetics and the chance to be more involved in their treatment plans, thanks to the ClinCheck software.

It is nice to please the patients, but making people happy cannot be our only criteria for choosing a technique. From a clinical point of view, the high success rate, the low caries rate, and the largely beneficial effect on the gingivae and periodontium would also appear to make Invisalign the appliance of first choice compared to fixed appliances. Indeed, the appalling rates of demineralisation seen with traditional appliances mean that in a country that has embraced chocolate and soft drinks so whole-heartedly, fixed appliances would appear to be unjustifiable for simple procedures, while severe rotations and the need for gross torque would appear

to ensure that fixed appliance therapy will still have a role in the foreseeable future.

During my first one hundred cases I discovered that the guidelines mentioned above regarding extrusions, rotations and translations, were indeed just that: guidelines. It is right and proper to be concerned about the potential limitations of any new technique and to only cautiously test the boundaries of what is possible. Looking back over my first one hundred cases, I would concur that these are precisely the areas where a clinician should show the utmost caution, but this is more in terms of observing the case carefully and, if need be, taking it slowly.

Possibly the biggest lessons I learnt were that this is a technique that is all about planning and communication and very little to do with using your hands. With ClinCheck we have an excellent tool to plan treatment

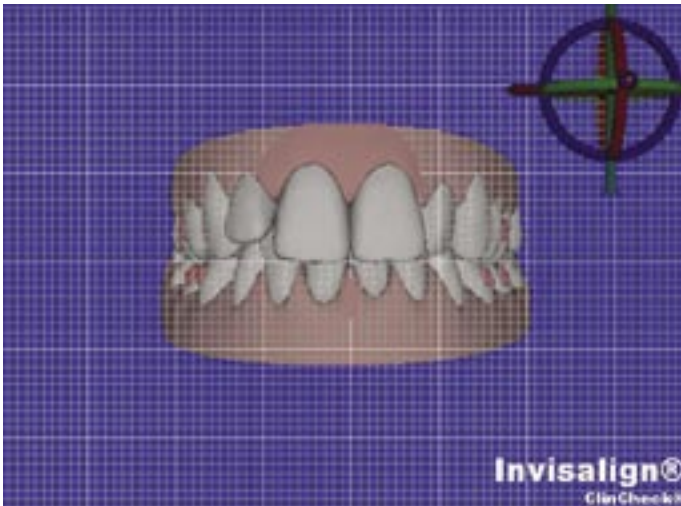


Figure 12: Clincheck with grid to ensure no movement for upper central incisors

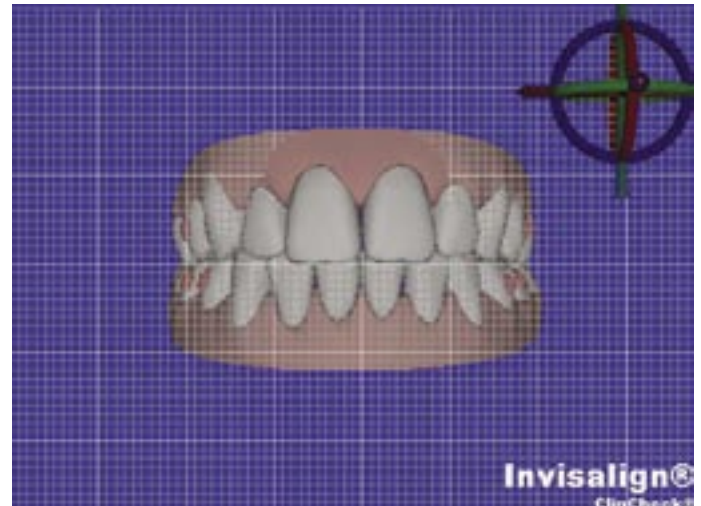


Figure 13: ClinCheck after treatment

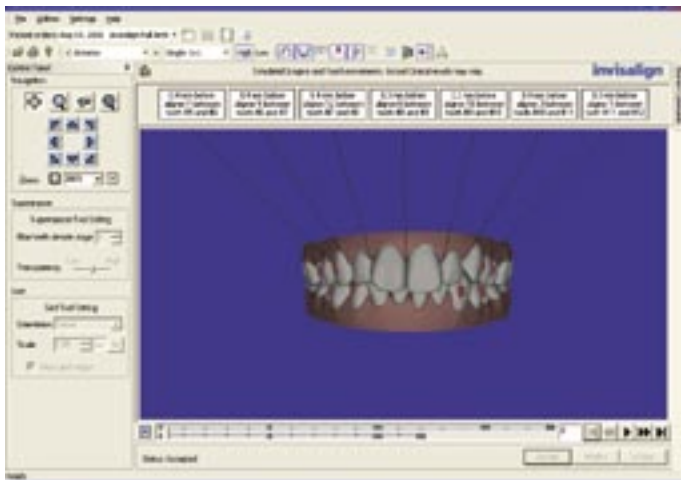


Figure 14: Example of a computerised case transfer



Figure 15: The transferred case completed

and explain details to the patients and manage their expectations. Get the plan right at the outset, and the rest will nearly always fall into place thereafter.

## References

Ahmad, I., (2005) Anterior dental aesthetics: Dentofacial perspective, *British Dental Journal* 199, 81 - 88  
 Gorelick, L., Geiger, A. M. and Gwinnett, A. J. (1982) Incidence of white spot formation after bonding and banding, *American Journal of Orthodontics and Dentofacial*

*Orthopedics*, 81, 93–98.  
 Lopez-Gavito, G., Wallen, T.R., Little, R.M., and Joondeph, J.R (1985) Anterior Open-bite Malocclusion. Longitudinal Ten Year Post Retention Evaluation of Orthodontically Treated Patients. *American Journal of Orthodontics and Dentofacial Orthopedics*, 87, 175 - 186  
 O'Reilly, M., Featherstone, J., (1987) Demineralisation and remineralisation around orthodontic appliances – an in vivo study *American Journal of Orthodontics and Dento-Facial Orthopedics* 93, 29-37

Taylor, M.G.; McGorray, S.P.; Durrett, S.; Pavlov, S.; Downey, N.; Lenk, M.; Oxford, E.; Dolce, C.; and Wheeler, T.T.: (2003) Effect of Invisalign aligners on periodontal tissues, *Journal of Dental Research* 82 (Spec. Iss. A):1483.  
 Travess, H., Roberts-Harry, D., Sandy, J., (2004) Risks in orthodontic treatment *British Dental Journal* 196, 71 – 77  
 Turatti, G., Womack, R., Bracco, P., (2006) Incisor Intrusion with Invisalign Treatment, *Journal of Clinical Orthodontics* 40 : 171-174