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# What does rotary mono-instrumentation (OneShape®) bring to the shaping of the canal system?

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**Abstract**
Root canal shaping is a critical step in endodontic therapy. Peroperative errors such as: false canal, stripping…, may occur during this step.
Endodontic instrumentation based on stainless steel is often the cause of these errors because of the alloy rigidity of which it is made. To alleviate this problem, endodontic NiTi instrumentation was designed and then used to allow a better respect of the canal trajectory, thanks to the flexibility of the NiTi alloy.
One Shape® (Micro Méga, Besancon, France), is a NiTi root canal shaping system, a single file used in continuous rotation.
The aim of the present paper is to highlight the aspects of rotary mono-instrumentation and its additions to the root canal shaping.

**Keywords:** OneShape®, mono-instrumentation, shaping

## Introduction
Endodontic therapy aims to treat diseases of the pulp and periapical tissues, in order to keep the tooth asymptomatic and functional.
The success of endodontic therapy depends on several factors. One of the important steps in endodontic treatment is the root canal shaping. This is an essential step because it optimizes the disinfection of the canal system and its obturation afterwards [1].
The concepts of root canal shaping have evolved together with the evolution of endodontic instrumentation.
Stainless steel-based instrumentation has shown some limitations compared to rotating NiTi instrumentation (Canal transportation, perioperative incidents: ledging, stripping...) [2].
Thus, several rotary systems are marketed, with different instrumental profiles, different designs and different operating protocols.
In 2008, Yared proposed to review not only the design of the instrument but also its dynamics, thus defining the concept of the unique instrument working in reciprocity with as advantages over the continuous rotation [3, 4].

- reduced working time;
- A shorter learning curve;
- Simplicity and ease (reducing the number of instruments needed for shaping of the root canal system);
- Safety concerning the instrumental fracture.

However, these instruments animated by the reciprocal movement, require the acquisition of a specific motor.
In 2012, the OneShape® system, consisting of a single instrument working in continuous rotation, was put on the market.
In this paper, we will try to answer the following questions: Does the single-use rotary instrument respect the canal trajectory better than full-sequence systems? Does it reduce the time for root canal shaping? Is the instrumental fracture less with rotating mono-instrumentation?

## The OneShape® system
The OneShape® is a relatively new canal shaping NiTi instrument working in a continuous rotation. The instrument is marketed in sterile blisters, ready to use. (Source: micro-mega)

The OneShape® instrument has a tip diameter of 25/100 and a regular taper of 6%, the instrument has an asymmetrical variable section (fig.1), all along the blade [5].

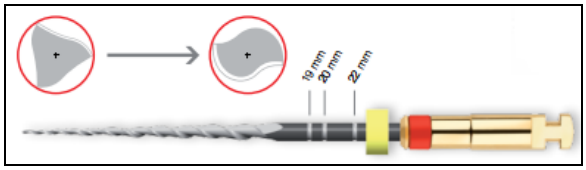



**Fig 1:** The OneShape® has a variable section all along the blade [5].

- In the apical part: three symmetrical cutting edges
- In the middle part: only two sharp edges, this middle part is asymmetric
- In the coronal part: two sharp edges in the shape of an elongated S

**Respect for the original canal anatomy**

Conventional endodontic instrumentation based on stainless steel would be less effective in terms of respect of the initial canal trajectory compared to the NiTi instrumentation [6].

The rotating NiTi systems, existing on the market, have different instrumental designs; their behaviour would be different from each other in contact with the root canal.

In the study by Tambe and al [7]. evaluating the ductal transport of three canal shaping systems: The ProTaper®universal system, the OneShape® and the WaveOne®, the authors found that the ProTaper®universal caused more canal transport than other systems (fig.2).

This would be due, according to Maitin and al, to the consistent conicity of the ProTaper®universal system and its reduced flexibility [8], on the one hand, the OneShape® has a variable section on the whole active part of the instrument and three cutting lips supposed to improve its flexibility and guidance within the canal [9].

In the study by Çeliktan and al [10] comparing two rotary root canal shaping systems, ProTaper® Next and OneShape®. The authors emphasized that there was no significant difference between the two systems regarding their respect for the initial canal trajectory.

In the study by Capar and al [11] studying six root canal shaping systems, whose kinetics and instrumental design are different from one to another (OneShape®, ProTaper® NEXT, ProTaper®universal, Reciproc®, Adaptive Twisted File / Adaptive TF ™, WaveOne®).

The authors concluded that there was no significant difference between the six systems regarding respect for the initial canal anatomy during the shaping of severely curved root canals.

**Fig 2:** radiograph showing a recovery of the canal trajectory at the mesial root of a 46, the shaping being performed by the ProTaper ®universal system.

Besides the endodontic instrumentation used, other elements influence the respect of the initial canal trajectory [12].

- Insufficient irrigation during canal shaping.
- A forced instrument within the root canals.
- Access cavity insufficiently drafted.
- The degree of canal curvature. In fact, the greater the degree of curvature (small radius of curvature), the greater the risk of canal transportation.

These elements could explain the difference of results between the studies mentioned above.

**Fracture resistance**

One practitioner out of two would have experienced the fracture of rotary NiTi instruments, with the complications of the removal of fractured instruments (ledge, false canal, canal transportation) [13]. The failure of the rotating NiTi instrumentation would be due to cyclic fatigue or torsional stress.

The torsional stress fracture (fig.4) occurs when the NiTi file is blocked in the canal, it undergoes at first a temporary elastic deformation, if the torsion continues the deformation becomes permanent and the instrument breaks [14].

Cyclic fatigue fracture (fig.5) is related to the degree of canal curvature. In a curved canal, the rotating file undergoes torsion / compression cycles whose forces are maximum when the radius of curvature is small (fig.3). The continuous variation of these stresses leads to fatigue of the alloy and therefore a fracture of the NiTi file [14].

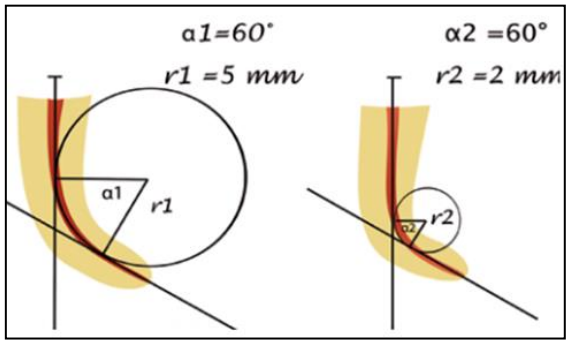



**Fig 3:** characteristics of a curved channel: α: curvature angle / r: the radius of curvature) for channels with the same degree of curvature, but with different radii of curvature. The risk of instrumental fracture is increased in the case of a small radius of curvature (the situation on the right) [15].

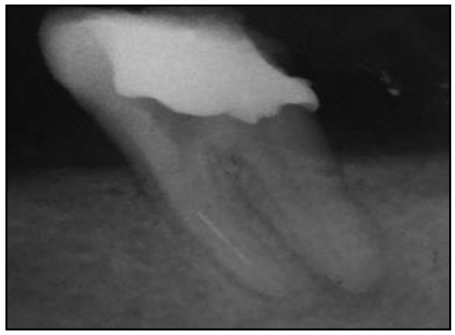


**Fig 4:** radiograph showing an instrumental fracture of Finishing file 1 of the ProTaper®universal system; the fracture occurred beyond the curvature of the canal, possibly by torsion since it was a first use of the instrument.

Apart from the concept of canal shaping, other factors predispose to instrumental fracture: canal configuration, number of instrument use, operator experience and expertise, cleaning and sterilization procedures of endodontic instruments [16].

**Fig 5:** photograph showing a fractured ProTaper® (shaping file X) instrument. The instrument broke when inserted into the canal. We could speculate that it is a cyclic fatigue fracture by looking at the wear marks on the instrument's handle, adding that the instrument did not have time to be sheathed in the canal.

Panna and al found that the OneShape® system could be used up to five times without risk of fracture (equivalent to 5 canals shaping) [17].

In the karova and al study, the OneShape® system would have an average life comparable to that of other rotating systems [18].

In the Gündoğar and al study, comparing the cyclic fatigue resistance of OneShape®, WaveOne® Gold, Reciproc®Blue and HyFlex® EDM systems. The latter would have a greater resistance to cyclic fatigue, while the OneShape® system would be the least resistant compared to the other systems studied [19].

Moreover, in rotational movement, endodontic files frequently fracture by cyclic fatigue, with continuous alternation of compression and tension phenomena at a canal curvature [20].

Indeed, when it comes to a single instrument for shaping the canal, it would suffer and combine the stress of canal shaping, while the same stress would be shared by the instruments of multi-instrument systems.

The manufacturers recommend the realization of the canalization of a single tooth, or 3 to 4 channels of the same tooth, the instrument of the OneShape® system should not be sterilized, since the cutting efficiency decreases severely [18].

In the Mittal and al. Study [23]. The ProTaper®universal would project more bacterial debris than the OneShape® system.

**Debris extrusion**

Postoperative pain in endodontics (occurring in 24% to 24 hours or in 14% at one week), would be attributed, in the majority of cases, to extrusion of intracanalar debris, in the periradicular region [21].

The risk of extrusion of the root canal content would be common to all canal shaping concepts with an incidence that would vary depending on the endodontic instrumentation used [22].

In the Mittal and al. Study [23], the ProTaper®universal would project more bacterial debris than the OneShape® system.

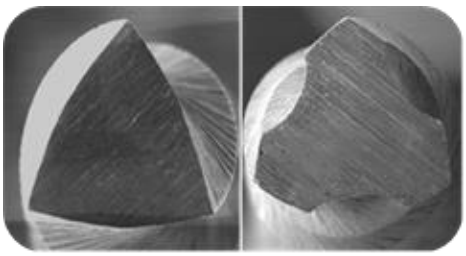


**Fig 6:** Cross section of ProTaper ®universal system instruments, right cross section of F3 / F4 / F5, left of Sx / S1 / S2 / F1 / F2 (according to maillefer)

In the study by Ehsani and al [24], comparing the debris extrusion from six root canal shaping systems (Reciproc®, WaveOne®, OneShape®, F360®Neoniti A1® and ProTaper®universal), the risk of debris extrusion would be greater with ProTaper®universal than with other systems.

Also, according to Mittal and al, the OneShape® system has a coronal zone of 2 cutting edges, which can offer a space facilitating the recovery of debris towards the crown, unlike the ProTaper®universal system where this space is reduced [23].

In addition, the finishing files of the ProTaper®universal system possess a high conicity (F1: 7%, F2: 8% and F3: 9%), inducing wide apical preparation that can cause extrusion of previously detached debris by these same instruments [23].

In the study by Burklein and al (Burklein, 2013), the debris extrusion would be more important with the Reciproc® system, the authors added that there is no significant difference concerning the other rotary systems (Mtwo®, F360 ™, OneShape®).

In the study by Küçükyilma and al [27], the extrusion of intracanal debris would be greater with Reciproc®, while there is no significant difference for other rotary systems: the ProTaper®universal and the OneShape®.

In the study by Türker and al [28], comparing the rate of extruded bacteria with Twisted File ™, ProTaper NEXT ™ and OneShape® systems. The authors found that OneShape® would be associated with less bacterial extrusion beyond the apical foramen.

According to Türk and al [28], the number of endodontic instruments used for root canal shaping would be associated with the potential risk of debris extrusion. Sequences with multiple endodontic instruments would be accompanied by a significant risk of extrusion of debris compared to reduced endodontic sequences.

In addition, other factors would influence the amount of debris discharged: the length and width of the canal, the master apical file, the type and volume of the irrigation solution [27]. These factors could influence disparity of results between the studies mentioned above.

**Preparation time**

The preparation time of an endodontic instrument within a canal includes: activation and change of endodontic instruments, irrigation, and flute's cleaning [25], It would seem wise to think that the preparation time with the OneShape® system or other "mono-instrument" systems would be less compared to the root canal systems with a more exhaustive instrumental sequence (no need to change instruments).

In the Agrwal and al. Study [26], the OneShape® system would have reduced preparation time by 46.2% compared to the universal ProTaper®, which is consistent with the Ehsani and al study [24], According to the authors, the root canal shaping would require more time with the ProTaper®universal, this would be explained by the number of instruments needed for root canal shaping, whereas in the case of endodontic mono-instrumentation, only one instrument is needed for root canal shaping.

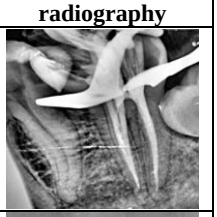
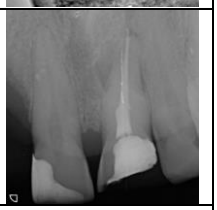
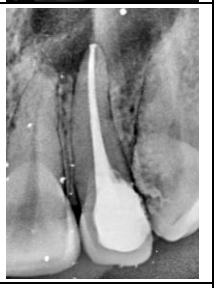
In the Burklein and al [25], study, Reciproc®, F360 ™, OneShape® systems would have reduced preparation time by 60% compared to Mtwo® (full-sequence system).

However, the reduction of preparation time reduces the time of action of the irrigation solution, knowing that 35% of the canal surface remain un-instrumented [29], and it is to the irrigator to remedy it; The authors propose [30],

A constant renewal of the irrigation solution; increase solution

irrigation concentration up to 5.25%; Activation of the irrigation solution.

**Table 1:** Clinical cases with canal shaping performed by the OneShape ® system

| Clinical case | Preoperative radiography | Postoperative radiography |
|---|---|---|
| *Tooth: 37 *initial diagnosis: acute pulpitis |  |  |
| *Tooth: 21 *initial diagnosis: chronic apical periodontitis |  |  |
| *Tooth: 22 *initial diagnosis: chronic apical periodontitis |  |  |
| *Tooth: 15 *initial Diagnosis: acute apical abscess |  |  |
| *teeth: 11 and 21 *initial Diagnosis: chronic apical periodontitis |  |  |

## Conclusion

The canal preparation technique using only one rotary instrument would have the following advantages:

- Optimisation of time's preparation.
- The elimination of the risk of cross-contamination.
- The risk of instrumental failure by cyclic fatigue would be lower, by time-limited use.

On the other hand, endodontic mono-instrumentation, by definition proper, would not exist for the moment, in fact, for a complete canal shaping; current single-instrument systems would require a sequence for glad path creation and an instrument opener.

In addition, other studies will be desirable, with a high level of evidence, to shed further light on the clinical dimensions of endodontic mono-instrumentation (reduction of bacterial load, respect of initial endodontic anatomy, extrusion of debris in the periapex...).

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