UNIVERSITY OF BAGHDAD

جامعة بغداد

كلية طب الاسنان

Treatment in orthodontics
“ An update on orthodontic wires ”
Part one : the metal ones

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Archwires are a very important and integral part of treatment with fixed orthodontic appliances, with the development in the field of orthodontics

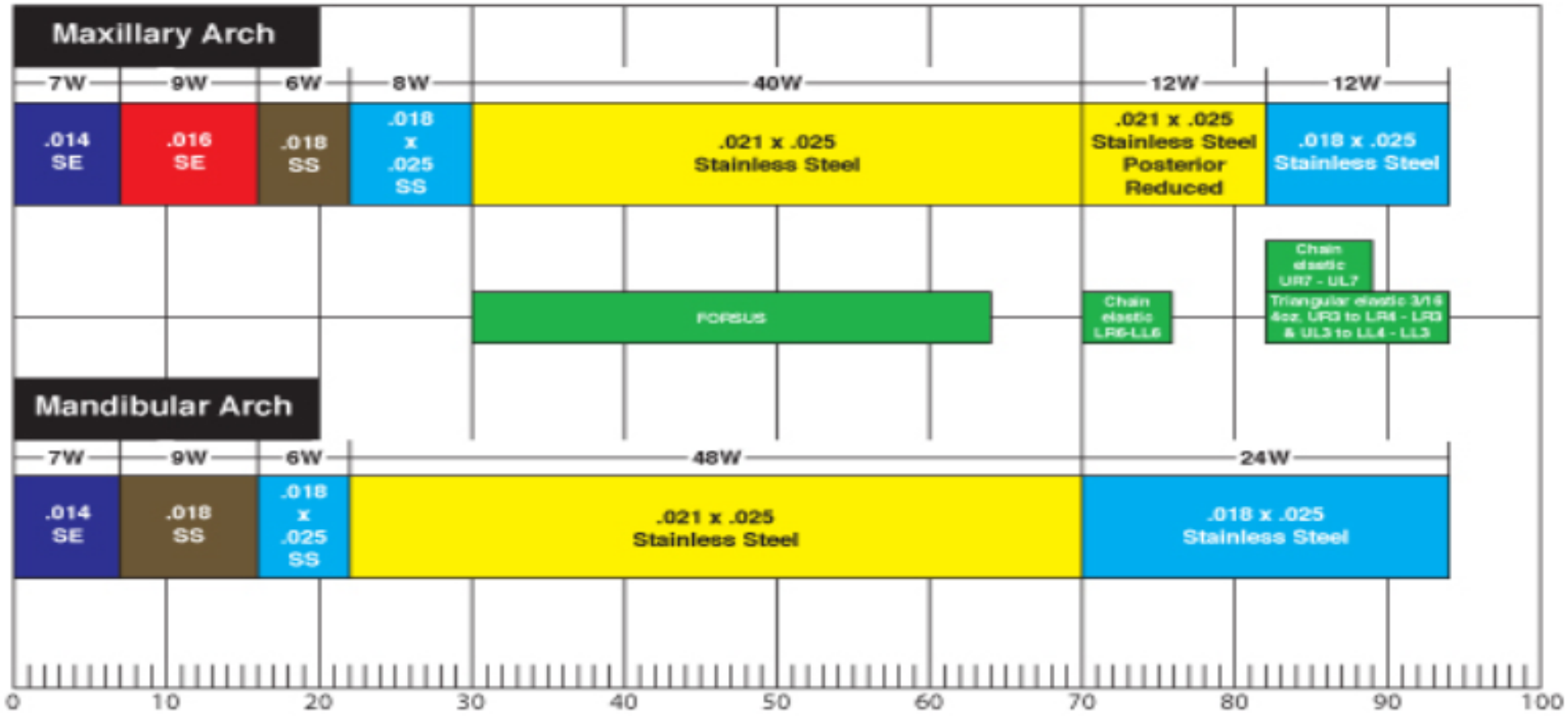
Many newer arch wires have came up that

provide a clinician variety of options to choose from.

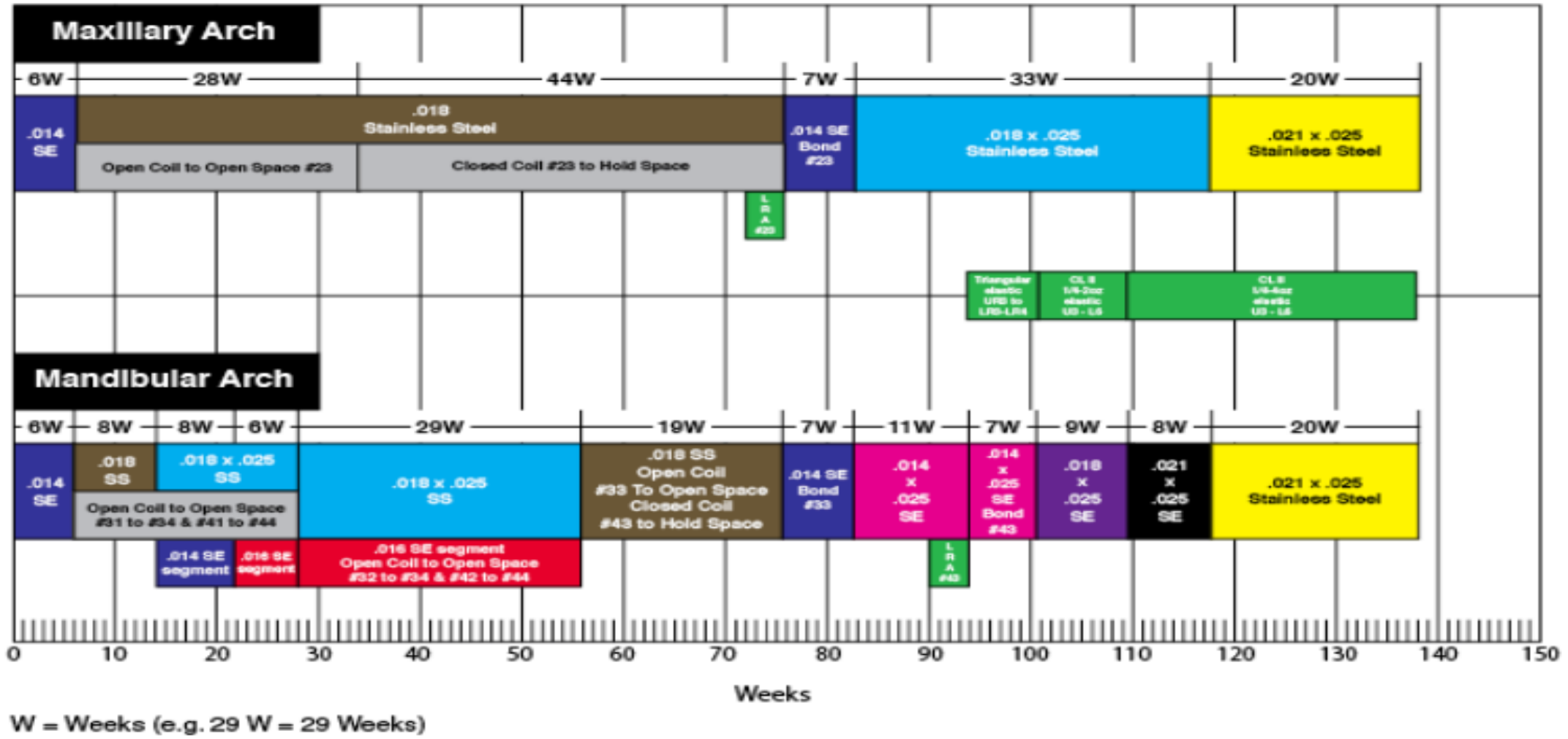
provide a lot of advantages over conventional wires in terms of:

- **Efficiency,**
- **Total treatment time,**
- **And finishing.**

Archwire Sequence

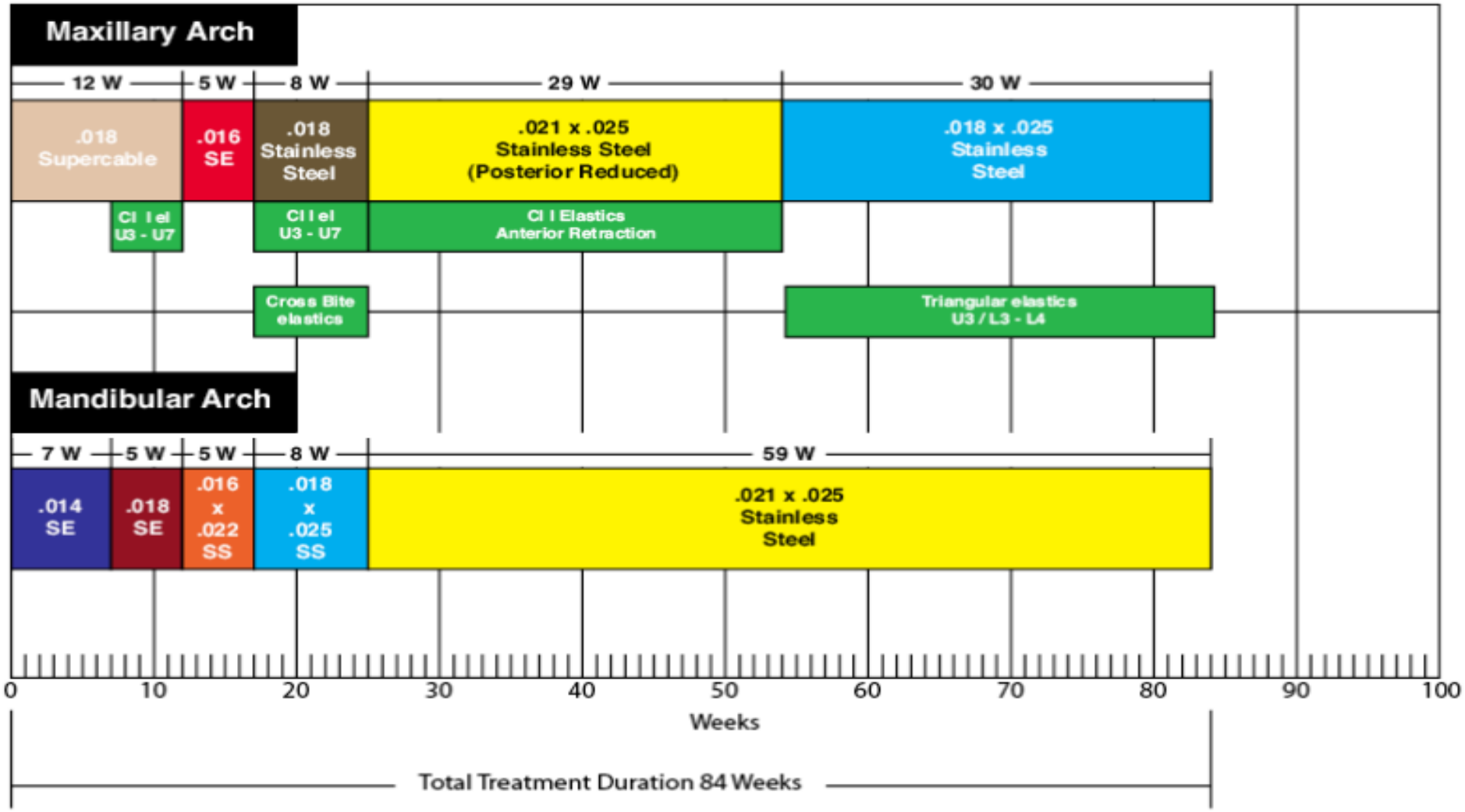


Archwire Progression:



W = Weeks (e.g. 29 W = 29 Weeks)

Speed System



W = Weeks (eg. 29 W = 29 Weeks)

Our goal as orthodontists should be to **increase efficiency** rather than accelerate treatment, because if efficiency is improved, accelerated treatment will follow.

Various newer archwires includes:

supercable,

copper NiTi,

timolium,

titanium-niobium,

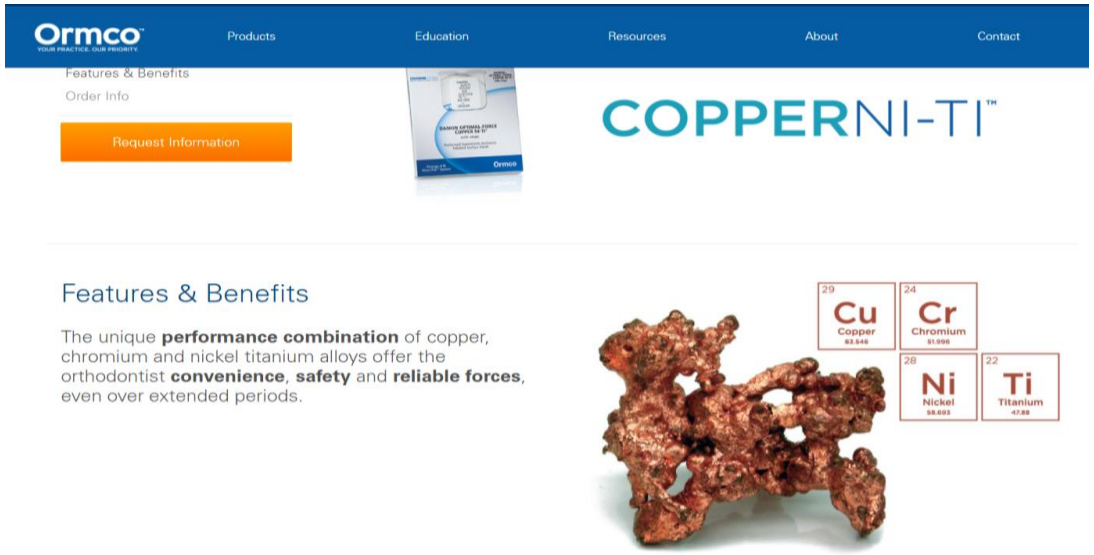
bioforce wires,

wires specifically designed for speed self ligating brackets,

smart arch wire,

bactericide niti wire coated with silver nano particles etc

Copper NITI Wires



- Introduced by Rohit Sachdeva,
- Produced by Ormco company in 1994

which contains 5-6% copper, and 0.5- 5% chromium in addition to nickel and titanium.

Copper is added

Adv> **Decreases** energy loss during unloading

Disadv> **Increases** phase transformation temperature above that of the oral cavity.

Chromium is added to **return** phase transformation temperature to 27 ℃.

Copper NITI Wires

Unloading force more closely resembles the **loading force,** due to reduced mechanical hysteresis.

This makes it easier to insert large sized rectangular wires without creating undue patient discomfort.

Types of Copper NiTi:

Type I: (AF =15 ℃)

It generates very high force and has few clinical indications.

Type 2: Super-Elastic

(AF= 27 ℃) It generates highest force among all the types.

It is best used :

- Patients who have an average or higher pain threshold,
- In mouth breather patient.
- Patients with normal periodontal health
- and patients where rapid tooth movement is required and force system generated by the wire is constant.

Type 3: Thermo-Active

(AF=35 ℃)

- It generates force in mid range, Activated at normal body temperature.

and best used in:

- patients who have a low to normal pain threshold,
- periodontium normal to slightly compromised,
- and when low forces are desired.
- When earlier engagement of full-size wires and sustained unloading forces at body temperature is desired, this is the **ideal wire.**

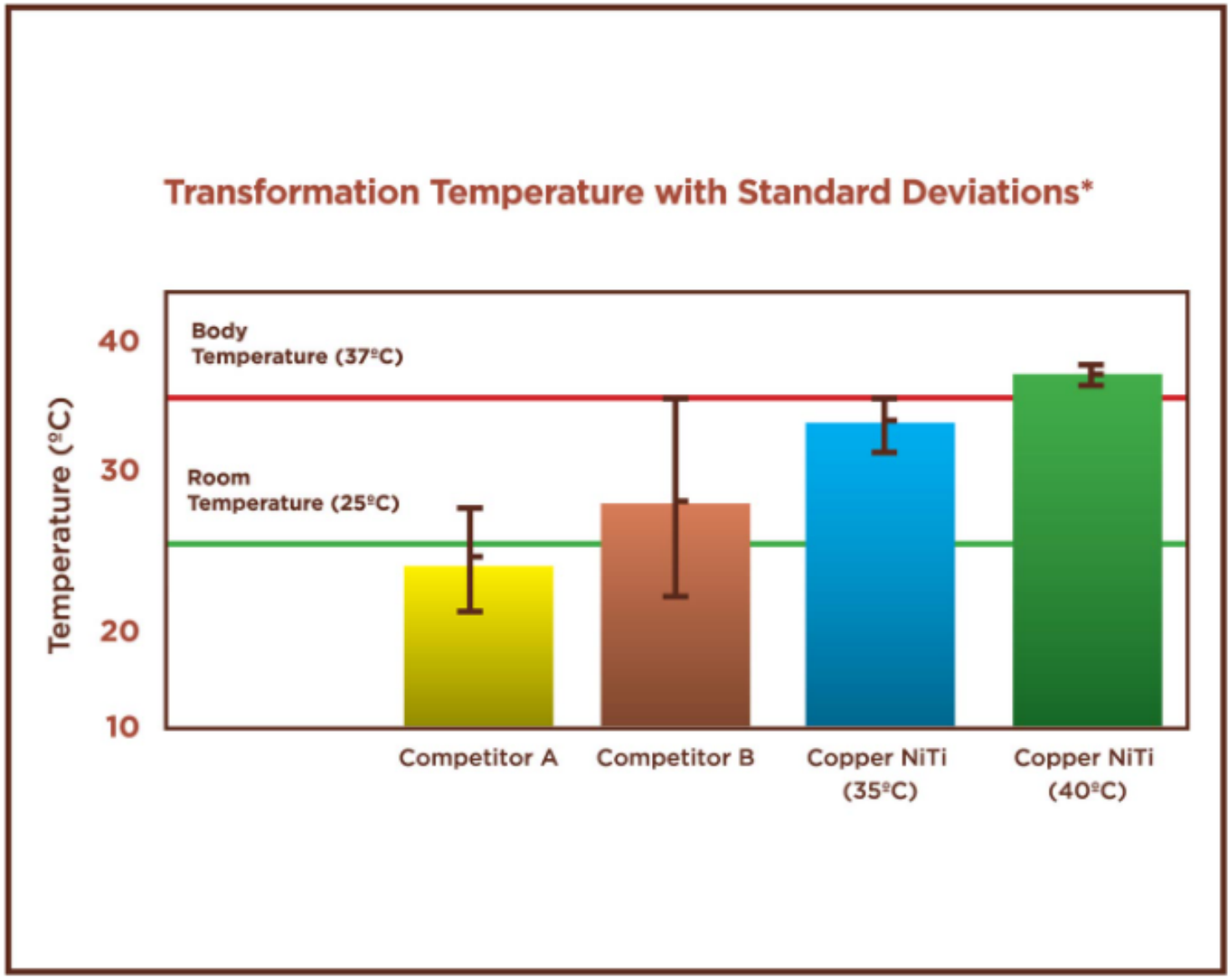
Type 4 : Thermo-Active

(AF=40 ℃)

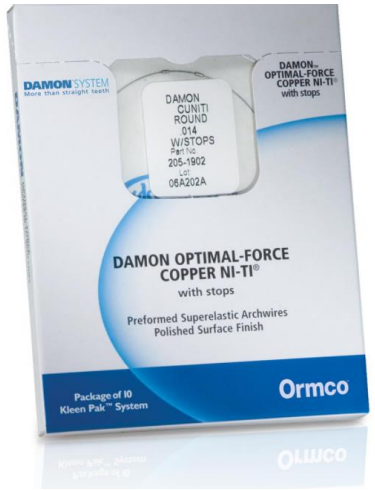
These wires generate forces when mouth temperature exceeds 40 ℃ (after consumption of hot food and beverages).

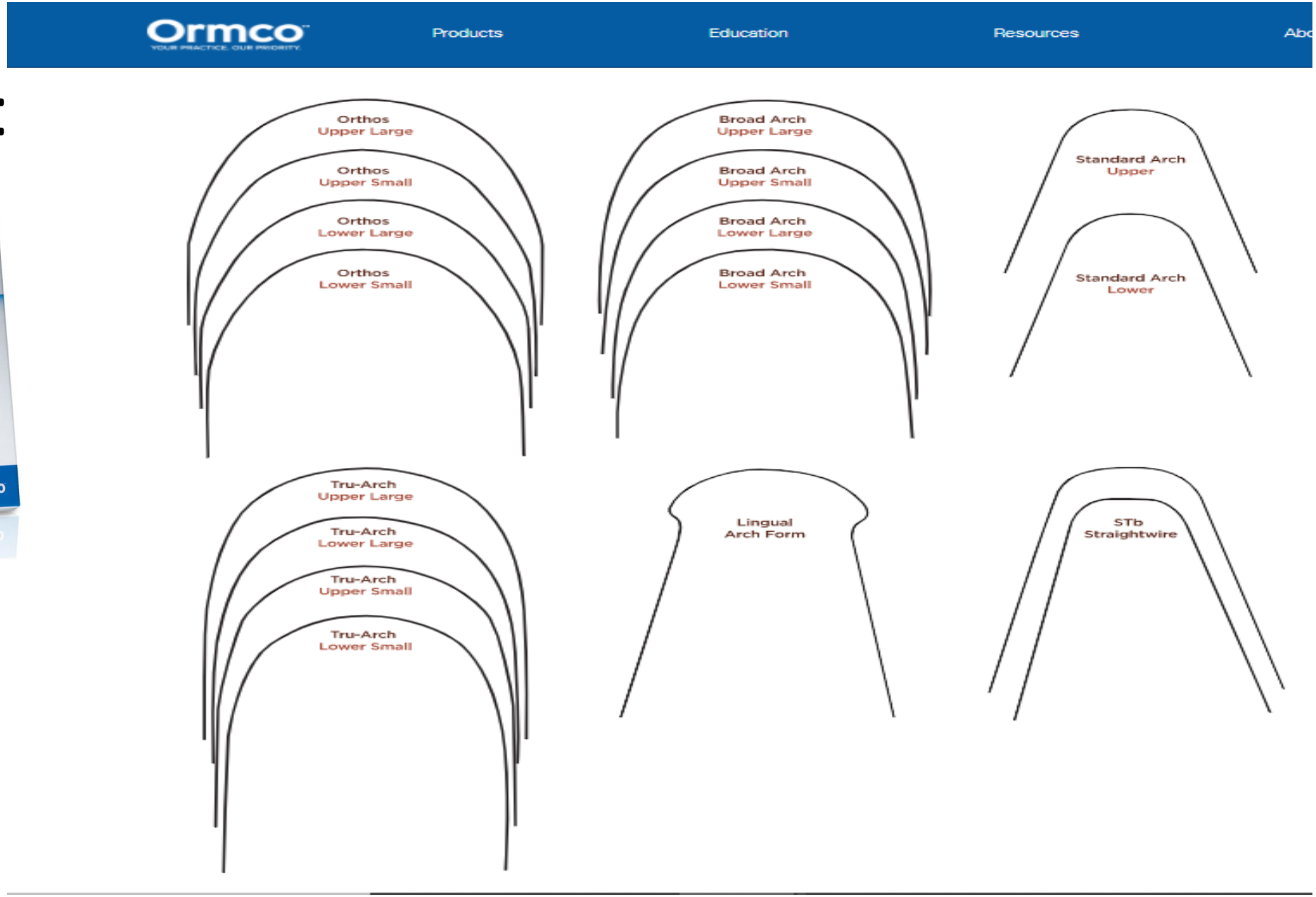
It is best used in :

- patients who are sensitive to pain(low pain threshold),
- with compromised periodontal condition
- and poor patient cooperation.
- choice for patients scheduled for long intervals between visits.


Transformation Temperature with Standard Deviations*
Temperature (ºC)
40
30
20
10
Body
Temperature (37ºC)
Room
Temperature (25ºC)
Competitor A
Competitor B
Copper NiTi
(35ºC)
Copper NiTi
(40ºC)

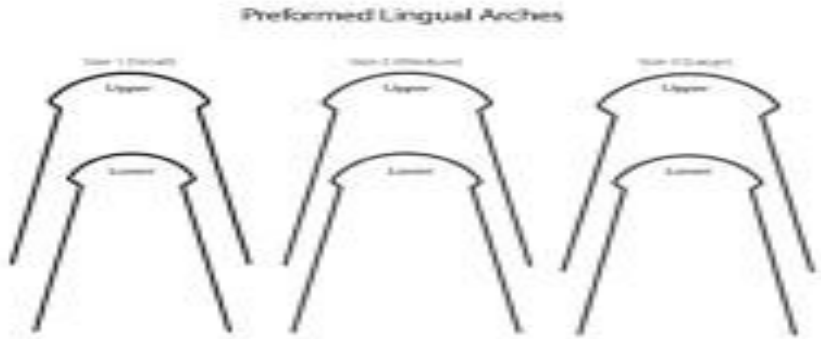
Forms &sizes:

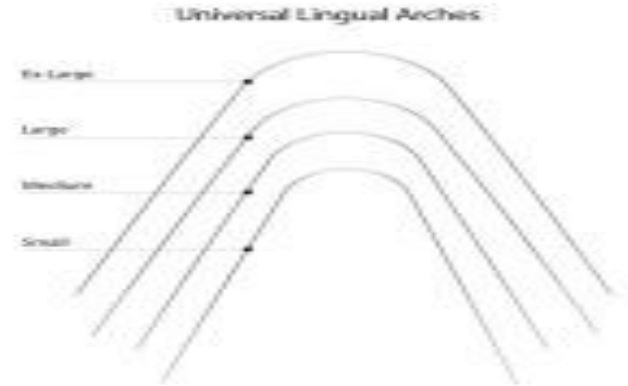

DAMON SYSTEM
More than straight teeth
DAMON CUNITI ROUND 014 W/STOPS
205-1902
06A202A
DAMON OPTIMAL-FORCE COPPER NI-TI® with stops
DAMON OPTIMAL-FORCE COPPER NI-TI®
with stops
Preformed Superelastic Archwires
Polished Surface Finish
Package of 10
Kleen Pak™ System
Ormco


Ormco
YOUR PRACTICE. OUR PRIORITY.
Products
Education
Resources
Orthos Upper Large
Orthos Upper Small
Orthos Lower Large
Orthos Lower Small
Broad Arch Upper Large
Broad Arch Upper Small
Broad Arch Lower Large
Broad Arch Lower Small
Standard Arch Upper
Standard Arch Lower
Tru-Arch Upper Large
Tru-Arch Lower Large
Tru-Arch Upper Small
Tru-Arch Lower Small
Lingual Arch Form
STb Straightwire


M5
THERMAL
COPPER
NICKEL TITANIUM
G&H
ORTHODONTICS
ARCHWIRES


Europa™ I
Trueform I
Trueform II
Standard Form
Europa™ II
Bioform I
Bioform II
Bioform III
Bioform IV
Bioform V


Preformed Lingual Arches


Universal Lingual Arches

Damon Arch Form

Arch Form	Part Number						
Damon	.013	.014	.016	.018	.014 x .025	.016 x .025	.018 x .025
Damon	205-1909	205-1902	205-1903	205-1904	205-1905	205-1906	205-1907

Orthos® Arch Form

Arch Form	Part Numbers
27° C Orthos—No Dimple	**.018**
Upper Small	219-0204
Lower Small	219-0104
Upper Large	219-0404
Lower Large	219-0304
27° C Orthos—Dimple	**.018**
Upper Small	219-7210
Lower Small	219-7202
Upper Large	219-7226
Lower Large	219-7218

Tru-Arch® Arch Form

Arch Form	Part Number					
27° C Tru-Arch—Dimple	**.014**	**.016**	**.018**	**.014 x .025**	**.016 x .022**	**.016 x .025**
Upper Small	205-6221	205-6222	205-6223	210-9121	210-9123	
Lower Small	205-6121	205-6122	205-6123	211-9121	211-9123	211-9122
Upper Large	205-6421	205-6422	205-6423	210-9221	210-9223	210-9222
Lower Large	205-6321	205-6322	205-6323	211-9221	211-9223	211-9222
27° C Tru-Arch—Stops	**.014**	**.016**	**.018**	**.014 x .025**	**.016 x .022**	**.016 x .025**
Upper Large	227-1360					
Lower Large	227-1361					

Arch Form	Part Numbers							
35° C Orthos—No Dimple	.016	.018	.017 x .017	.020 x .020	.016 x .022	.017 x .025	.019 x .025	.021 x .025
Upper Small	219-4203	219-4204	219-4209	219-4211	219-4208	219-4210	219-4212	219-4213
Lower Small	219-4103	219-4104	219-4109	219-4111	219-4108	219-4110	219-4112	219-4113
Upper Large	219-4403	219-4404	219-4409	219-4411	219-4408	219-4410	219-4412	219-4413
Lower Large	219-4303	219-4304	219-4309	219-4311	219-4308	219-4310	219-4312	219-4313
35° C Orthos—Dimple	.016	.018	.017 x .017	.020 x .020	.016 x .022	.017 x .025	.019 x .025	.021 x .025
Upper Small					219-7311		219-7315	
Lower Small					219-7303		219-7307	
Upper Large					219-7327		219-7331	
Lower Large					219-7318		219-7323	

Arch Form	Part Number							
35° C Tru-Arch—No Dimple	.016	.018	.020	.016 x .022	.017 x .017	.017 x .025	.019 x .025	.020 x .020
Upper Small	205-6212	205-6213		210-9113	210-9111	210-9114	227-1331	210-9112
Lower Small	205-6112	205-6113		211-9113	211-9111	211-9114	227-1333	211-9112
Upper Large	205-6412	205-6413		210-9213	210-9211	210-9214	227-1332	210-9212
Lower Large	205-6312	205-6313		211-9213	211-9211	211-9214	227-1334	211-9212
35° C Tru-Arch—Dimple	.016	.018	.020	.016 x .022	.017 x .017	.017 x .025	.019 x .025	.020 x .020
Upper Small	205-6232	205-6233		210-9133	210-9131	210-9134	210-9135	210-9132
Lower Small	205-6132	205-6133		211-9133	211-9131	211-9134	211-9135	211-9132
Upper Large	205-6432	205-6433		210-9233	210-9231	210-9234	210-9235	210-9232
Lower Large	205-6332	205-6333		211-9233	211-9231	211-9234	211-9235	211-9232
35° C Tru-Arch—Stops	.016	.018	.020	.016 x .022	.017 x .017	.017 x .025	.019 x .025	.020 x .020
Upper Small					227-1301	227-1311		227-1321
Lower Small					227-1303	227-1313		227-1323
Upper Large		227-1370	227-1372		227-1302	227-1312		227-1322
Lower Large		227-1371	227-1373		227-1304	227-1314		227-1324

35° C Tru-Arch—Stops	.016	.018	.020	.016 x .022	.017 x .017	.017 x .025	.019 x .025	.020 x .020
Upper Small					227-1301	227-1311		227-1321
Lower Small					227-1303	227-1313		227-1323
Upper Large		227-1370	227-1372		227-1302	227-1312		227-1322
Lower Large		227-1371	227-1373		227-1304	227-1314		227-1324

Arch Form	Part Numbers			
40° C Orthos	.016 x .022	.017 x .025	.019 x .025	.021 x .025
Upper Small	219-5208	219-5210	219-5212	219-5213
Lower Small	219-5108	219-5110	219-5112	219-5113
Upper Large	219-5408	219-5410	219-5412	
Lower Large	219-5308	219-5310	219-5312	

Arch Form	Part Number	
40° C Tru-Arch	.019 x .025	.021 x .025
Upper Small	227-1401*	227-1411*
Lower Small	227-1403*	227-1413*
Upper Large	227-1402*	227-1412*
Lower Large	227-1404*	227-1414*

Lingual Arch Form: STb Straight Wire Copper Ni-Ti®

Arch Form	Part Numbers			
Lingual	**.013**	**.016**	**.016 x .016**	**.018 x .018**
Upper 1	205-0076	205-0086		
Upper 2	205-0075	205-0085		
Upper 3	205-0074	205-0084		
Lower 1	205-0079	205-0089		
Lower 2	205-0078	205-0088		
Lower 3	205-0077	205-0087		
Small	204-2101	204-2111	204-2121	204-2141
Medium	204-2102	204-2112	204-2122	204-2142
Large	204-2103	204-2113	204-2123	204-2143
Straight Length	**.013**	**.016**	**.016 x .016**	**.018 x .018**
8.5" Straight	266-1360			

Titanium Niobium Wires

It was introduced in early 1995 by DR ROHIT SACHDEVA & Manufactured by Ormco
PROPERTIES:

- **Ti- nb is soft and easy to form, yet it has the same working range of stainless steel.**
- **Its stiffness is 20% lower than TMA and 70% lower than stainless steel.**
- **Ti-nb wire have a larger plastic range, similar activation and deactivation curves and relatively low spring back.**

Clinical applications: The low spring back and high formability of the titanium-niobium archwire allows creation of finishing bends Hence, this wire can be used as an finishing archwire.

(J. Clin orthod res. 2000 feb;3(1):6-14)
(Acta of Bioengineering and Biomechanics Original paper Vol. 22, No. 1, 2020)

TIMOLIUM TITANIUM ARCHWIRE

It is manufactured by TP ORTHODONTICS

Timolium archwires combines

-the flexibility, continuous force and spring back of nickel titanium with the high stiffness and bendability of stainless steel wire.

- Titanium is the major constituent of Timolium with aluminum and vanadium as stabilizing agents.
- Composition:

  Titanium – more than 85%

  Aluminium – 6.8%

  Vanadium - 4.2%

When compared to nickel titanium or beta titanium wire, (*angle orthod 2004;74:825–831.)*

Timolium outperforms in the following:

- More resistant to breakage,
- Smoother for reduced friction,
- Brightly polished and aesthetically pleasing,

- This alloy contains both stabilizing elements and both alpha and beta phases of titanium alloy and thus display a rare combination of strength and surface smoothness.
- Timolium with its smooth surface, reduced friction, low modulus, and better strength could be also considered as a breakthrough in clinical orthodontic practice

Advantages:

- Nickel free for sensitive patients,
- Easier to bend and shape,
- Can be welded
- Loops and bends can be made without breakage

- Compared with SS and BETA titanium
- Timolium was poor in its weld characteristics with large voids and wide gaps at the welded area

Clinical application

Timolium wire is excellent for all phases of treatment.

- During *initial* treatment :
  it is excellent for space closure, tooth alignment, levelling and bite opening.
- During *intermediate* treatment :
  early torque control can begin because of the moderate forces that are delivered.
- Final *treatment* phase:
  total control during detailing makes Timolium the wire of choice

References:

1. A comparative evaluation of metallurgical properties of stainless steel and tma wires with Tiolium and titanium niobium archwires by r devaki vijayalakshmi, ks nagachandran, pradeep kummi, p jayakumar (indian j dent res,20(4),2009

2. Mechanical Properties and Surface Characteristics of Three Archwire Vinod Krishnan, MDSa; K. Jyothindra Kumar, MDS, M. Orth RCS, MDO RCPS, FDS RCS Alloys (*Angle Orthod 2004;74:825–831.)*

BIO FORCE ARCHWIRE

Introduced by GAC

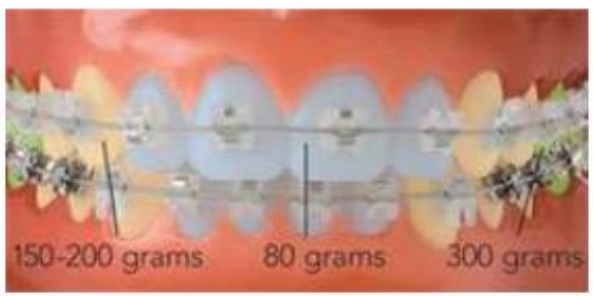
- It was possible to produce variation in force delivery between archwires of identical dimension

- This was possible by specifying transition temperatures within given ranges.
  And were graded as *thermodynamic* arch wires.

- This property was further advanced to produce variable transition temperatures within the same archwire
- This arch wire was called *Bioforce* archwire

- It is aesthetic
- Is the first and only family of biologically correct archwires
- It applies low and gentle forces to *anteriors*
- Increasingly stronger forces across the *posteriors* until plateauing at the molars.

- Beginning at approximately 100 grams
- increasing to approximately 300 grams
- It provides the right force to each tooth
- Reducing the number of wire changes &
- Providing greater patient comfort



Clinical applications:

- During initial stages when anterior torque is needed, use of an relatively large size (i.e. 0.018x0.025) can be given without the fear of significant root resorption.

During later stages of treatment i.e.

- If the posterior occlusion is not settled in,
- rotations have not been fully corrected or
- the bite opening is taking a long time because of the heavy musculature.

References:
1. Effect of coating on properties of esthetic orthodontic nickel-titanium wires by Masahiro Iijimaa; Takeshi Mugurumab; William A. Brantleyc; Han-Cheol Choed; Angle Orthodontist, Vol 82, No 2, 2012

COMBINED ARCHWIRES

- Introduced by James l. Cannon in 1984.

- The key to *success* in a *multi attachment* straight wire system is

  -To have the ability to use *light tipping* movements in combination with *rigid translation*

  -To be able to *vary* the location of either, at *any time* the need arises during treatment.

They used three specific combined wires for the technique

- ✓ Dual Flex-l,
- ✓ Dual Flex-2, and
- ✓ Dual Flex-3 (Lancer Orthodontics).

The Dual Flex-1

- it consists of a *anterior* section made of 0.016-inch round *Titanal* and a *posterior* section made of 0.016-inch round steel.

- The *flexible* front part easily *aligns* the anterior teeth and the *rigid posterior* part maintains the *anchorage* and molar control by means of the "*V*" bend, *mesial* to the molars.

- It is used at the *beginning* of treatment.

- **The Dual Flex-2**
  - it consists of a flexible anterior segment composed of an *0.016 ′ 0.022-inch rectangular* Titanal and a rigid posterior segment of round 0.018-inch steel.

The Dual Flex-3,

- This however, consists of a flexible anterior part of *an* ***0.017 ´ 0.025***-inch Titanal rectangular wire and a posterior part of ***0.018 square*** steel wire.

- The Dual Flex-2 and 3 wires establish ***anterior anchorage*** and control molar rotation during the closure of posterior spaces.
  They also initiate the ***anterior torque***.

References:

1. Combination anchorage technique: an update of current mechanics by Thompson WJ. Am J Orthod Dentofacial Orthop. 1988 May;93(5):363-79.

2. Dual-Flex Archwires by JAMES L. CANNON, DDS, MS JCO VOLUME 18 : NUMBER 09 : PAGES (648-649) 1984

Medical Grade Titanium Alloy Wires

As nickel, copper, molybdenum and chromium are allergen so medical grade titanium alloy is a pure titanium alloy, which is ideal for most sensitive patients.

GOLD NITI

- A NiTi wire coated with super hard 24 carat gold
- Allows silky smooth sliding mechanics and gives a fabulous rich look.

MULTISTRANDED WIRES

- Multistranded wires are made of a varying number of stainless steel wire strands coaxially placed or coiled around each other in different configurations.

- The important characteristics of these wires are development of low forces, low stiffness and a resilience and these wires are inexpensive than titanium alloys .

- They develop higher friction at bracket-wire interface compared to NiTi wires and single-stranded stainless steel wires .

D-RECT

- D-Rect is an eight-strand braided stainless steel wire.
- It can be used throughout treatment where lighter forces with dimensional control are indicated.

TRIPLE FLEX

- Triple Flex is a three-strand twisted stainless steel wire.
- It has moderately light forces and is used for initial leveling and alignment

RESPOND

- Respond is a stainless steel coaxial wire.
- It is recommended as an initial archwire to level and align because of its light, gentle forces.
- Respond is also very flexible and possesses great springback characteristics.
- One of the benefits of Respond includes great control with larger initial wire diameters.

PRODUCT CATALOGUE

ORMCO

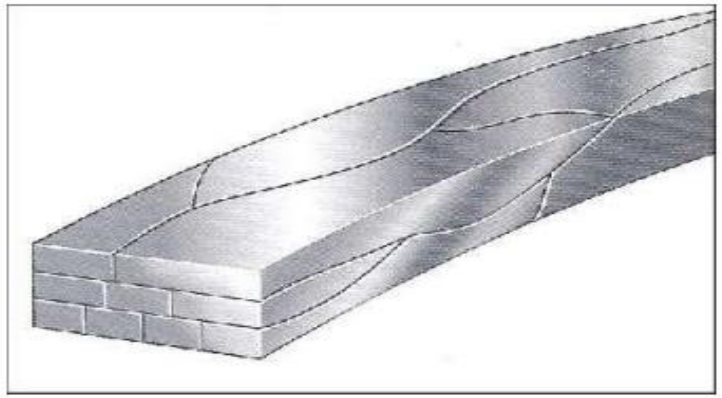
Force 9
(braided)

D-Rect
(braided)

Respond
(multistranded)

Triple flex
(triple stranded)

TURBO WIRE



- Turbo Wire is a nine-strand rectangular braided Ni-Ti, with low stiffness and great flexibility.
- Turbo Wire is recommended as an initial wire to unravel and level while controlling torque and engaging brackets fully.
- It is also effective as a finishing wire, retaining torque but allowing vertical elastic use

BIOTWIST NITI

- The bio-twist is a 0.021x 0.025 pre-form rectangular arch wire formed with multiple strands of titanium super elastic wires. This multistrand structure gives the wire.
- Low force and low stiffness with excellent flexibility and the rectangular shape allows significant engagement of slot.
- Bio twist wire is great for use at the beginning of treatment during the unraveling stage because it will facilitate leveling and aligning while also controlling torque.

Speed Super Cable:

In 1993, Hanson combined the mechanical advantages of multistrand cables with the material properties of superelastic wires to create a **superelastic** nickel titanium coaxial wire, called the Supercable.

It was found that both .016” and .018” Supercable wires exerted only 36-70% of the force of .014” regular nickel titanium wires and less than 100g of unloading force over a deflection range of 1-3mm.

Supercable thus demonstrates optimum orthodontic forces for the periodontium. This wire, comprises seven individual strands that are woven together in a long, gentle spiral to maximize flexibility and minimize force delivery.

The superelastic properties of Supercable allow full bracket engagement with extremely low unloading force delivery. The ideal initial archwire has superior strength and flexibility, resists permanent deformation, and maximizes both patient comfort and physiologic tooth movement.

Hills Dual Geometry Archwire:

It has been engineered to be an optimal wire for sliding mechanics in the posterior segments via a polished round posterior segment while ensuring maximum anterior incisor crown torque control with a square anterior segment.

The archwire is constructed with an ultra high tensile strength stainless steel with optimum stiffness.

The Hills archwire is available in 2 sizes:

0.018x0.018 inch anterior with 0.018 inch round posterior for the 0.018 slot

and 0.021 x 0.021 inch anterior with 0.020 inch round posterior for the 0.022 slot.

Speed Finishing Archwires :

The beveled labial-gingival shape of “SPEED” finishing archwires encourages full expression of the interaction between the superelastic spring clip, the archwire, and the archwire slot. Any deviation of the bracket position relative to the wire results in deflection of the spring clip, which stores appropriate energy for recovery

This energy is released gently through precise 3 dimensional tooth positioning. In addition, this quarter round archwire shape facilitates wire insertion and spring clip closure.

The rounded edge of the archwire is always directed occlusally in the labial-gingival in either arch. The wires are available in either:

0.017x0.022 inch for the 0.018 slot or

0.020x 0.025 inch for the 0.022 slot .

COLOURED TMA

- In the case of TMA the friction is probably due to its relative softness compared to the harder stainless steel bracket.
- Surface treatment can increase the hardness and reduce the coefficient of friction

ION IMPLANTATION

- Gas ions (nitrogen and oxygen)are simultaneously extracted from a plasma and accelerated in the growing physical vapour deposition(PVD) film.
- It is the process by which various elements are ionized and accelerated towards an arch wire in a vacuum chamber.
- This layer is extremely hard and creates a considerable amount of compressive forces in the material.

- The ions penetrate the surface of wires on impact, building up a structure that consists of both the original wire and a layer of tin compounds(TiN and TiO) on the surface of immediate sub surface

ADVANTAGES

- Compressive forces and increased surface hardness improve the fatigue resistance and reduce the coefficient of friction of the wire
- Does not alter the wire dimension thus it allows the production of high quality wires
- Ion implantation can take place at relatively low temperatures from sub zero to 700 degree c which allows improvement of surface characteristics without degradation of mechanical properties.
- Through an exclusive spi- spectrum ion beam implantation process ORMCO has introduced TMA colours. Coloured wires produced by varying ion type and thickness

- Colours available are Afran, Violet, Purple and Honeydew.
- This ensures a colour fastness not available in coated wire products.
- TMA colour gives patients some exciting new looks while at the same time providing with many clinical benefits of TMA wire.

Smart Arch Multi-Force Superelastic Archwires :

are manufactured by the method-known as multiple memory material technology-

which precisely programs transition zones as narrow as .001" in a crosssection of shape-memory alloy wire.

For example, 10 separate superelastic unloading zones can be programmed into a Copper NiTi wire.

Smart Arch archwire programming was based on specific PDL compressive stress values derived from Viecilli and Burstone's finite element modeling of digital dental templates.

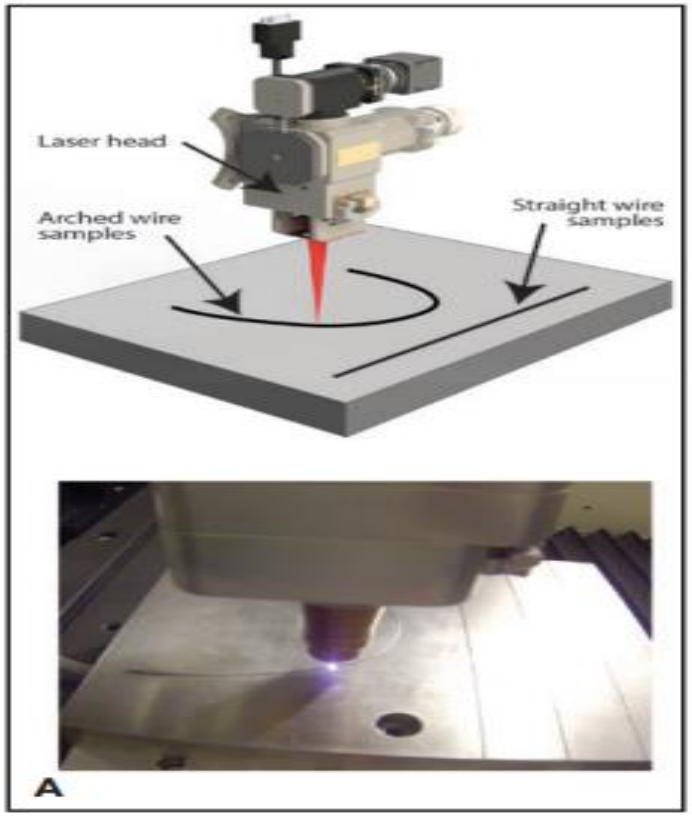
The result is an archwire with seven specific zones preprogrammed to apply appropriate forces to each individual tooth, both maxillary and mandibular .

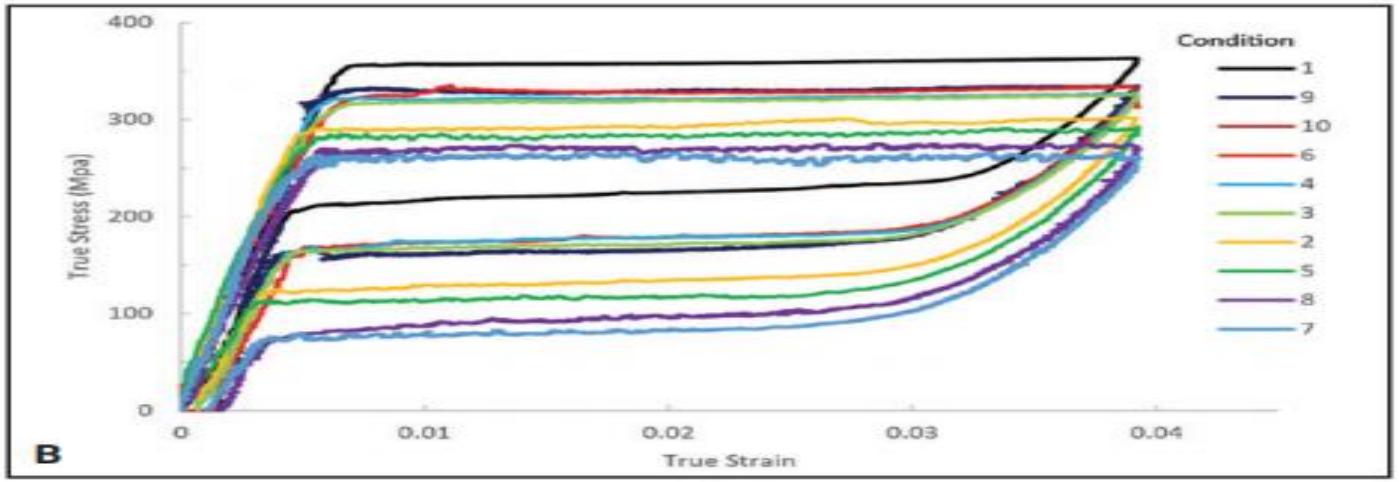
Smart Arch archwires deliver physiologically optimized forces over an extended period. With carefully applied orthodontic mechanics,

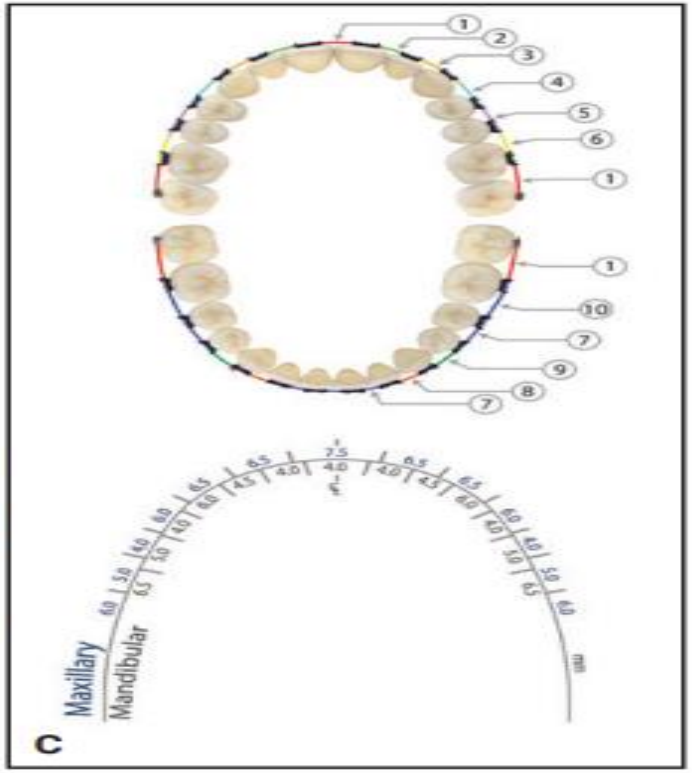
Smart Arch wires can shorten the lag phase, reduce adjustment and reactivation requirements, and avoid indeterminate mechanics, thus increasing orthodontic efficiency.

An ideal treatment sequence begins with an .016" Smart Arch Copper NiTi wire, moves into an .018" × .025" Smart Arch Copper NiTi wire, and finishes with either TMA or stainless steel archwires.

JCO/february 2020







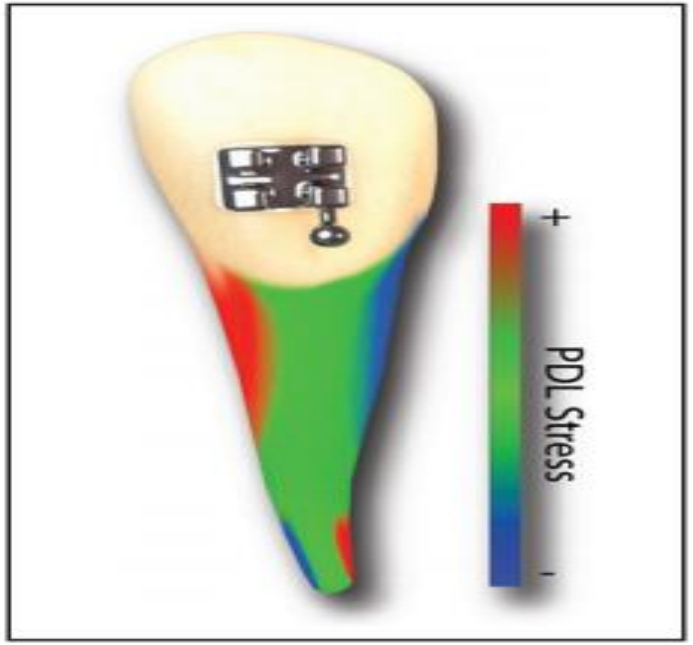


Fig. 2 A. SmartArch* wires produced with multiple memory material technology.[17] B. As many as 10 levels of stiffness can be incorporated into a Copper NiTi archwire. C. Key considerations include interbracket distances and stress on periodontal ligament (PDL).**

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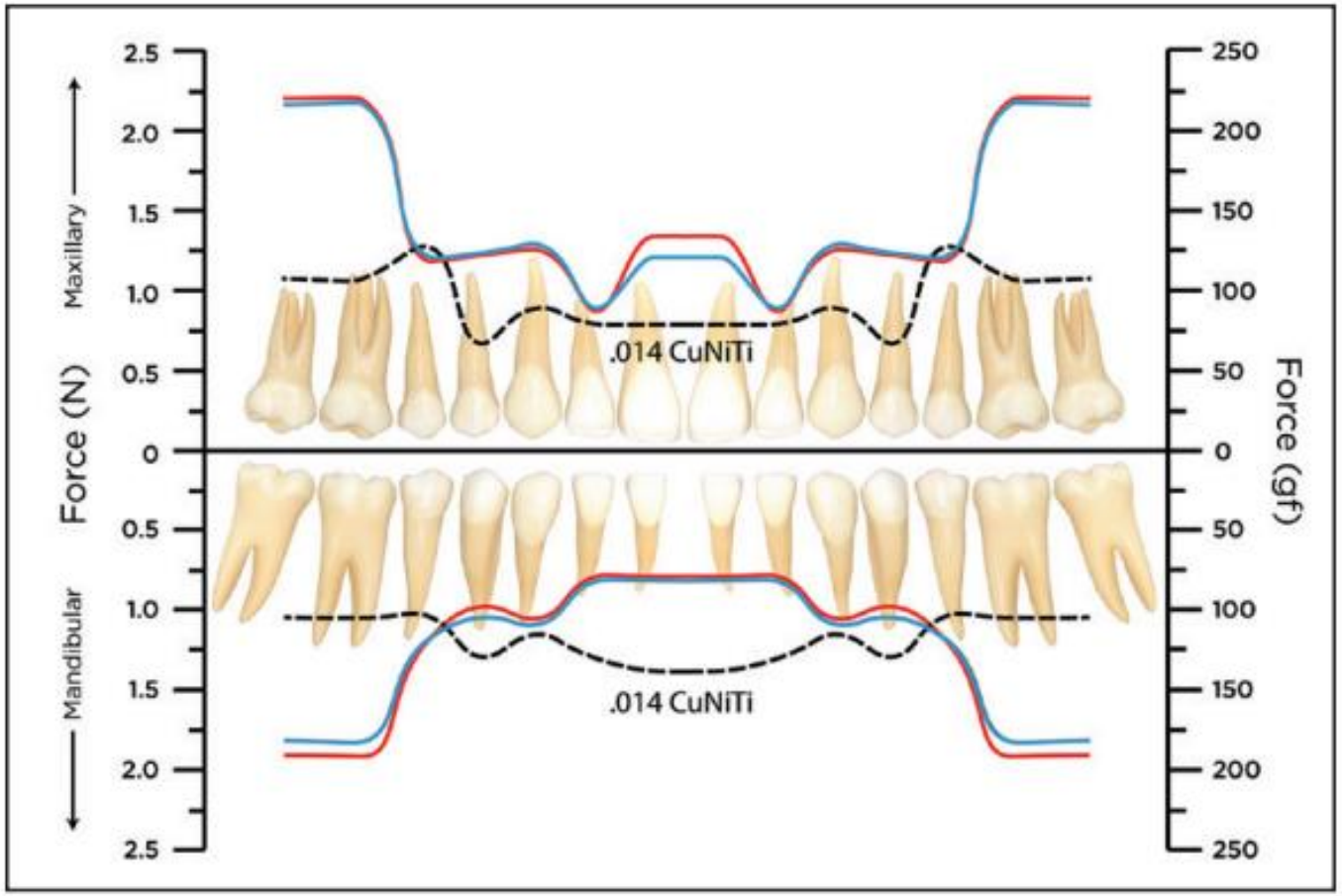


Comparison of ideal force (red line) and forces delivered by traditional nickel titanium archwires (dotted line) and SmartArch archwires (blue)

Basic considerations involved in Smart Arch diagnosis, treatment planning, and biomechanics include the following:

Wire placement: Bend the archwire to create stress-induced martensitic transformation. Any type of mild to moderate (1- 3mm) bend will suffice. Avoid sharp bends that cause permanent deformation and wire breakage.

Patience: Let the wire work. Allow time for the lag phase to finish and frontal resorption to take over. Any removal or adjustment of the wire causes a reversion to the lag phase. Resist the tendency to adjust too frequently.

Whole arch: Bond as many teeth as possible, including including second molars and blocked-out teeth, right from the start. This allows the biology to work consistently across the entire arch. Orthodontists will need to shift their paradigm from an “adjust at every appointment” (tinkering) mentality to an attitude of observing the body’s response to the mechanics and allowing the technology to work. Overactivation of Smart Arch wires reverts the patient into the lag phase, reducing efficiency and prolonging treatment.

New Bactericide Orthodonthic Archwire:

Niti with Silver Nanoparticles

The arch wires exert the forces to the teeth when placed into the slot of the brackets, that are bonded to the labial or lingual surface of the teeth. Oral hygiene, then, is more complicated for patients.

The normal development of dental biofilm is favored due to the adhesion of dental plaque around the brackets. Then, the chances for developing an enamel decay or a gingivitis and further development of periodontal disease is a real situation.

So this new bactericide orthodontic NiTi arch wire was developed by means of electrodeposition of silver nanoparticles, without any further loss of mechanical properties, that can help to control the dental plaque in patients bearing brackets. Bacteria culture results showed that the reduction of the bacteria due to the presence to the nanoparticles of silver is higher than 90%. Consequently, the new treatment with nanoparticles of silver could be a good candidate as bactericidic orthodontic archwire .

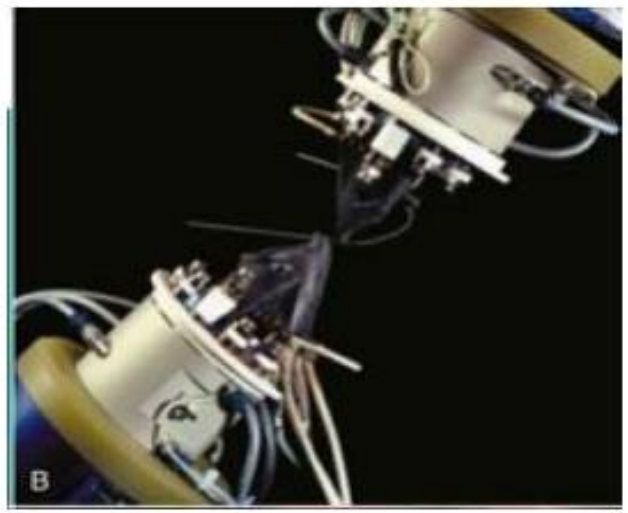
Javier Gil F. New bactericide orthodonthic archwire: niti with silver nanoparticles. Metals May 2020;10-702:1-12

WIRE BENDING ROBOTICS

- Computer-controlled machine to shape the archwire as desired.
- Reducing the amount of clinical time spent bending archwires.
- In lingual orthodontics, the scanned casts needed for fabrication of custom bracket pads provide the data needed to generate computer fabricated archwires

- Suresmile technique

- Uses the data acquired via intraoral scan to shape the finishing archwires.



Development of a Robotic System for Orthodontic Archwire Bending

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Abstract— **Customized archwires are demanded in the lingual orthodontic treatment for patients suffering from malocclusion. Traditionally, these archwires could only be bent by experienced orthodontists manually. This pattern requires a specialized skills training and occupies long charside time, but still cannot ensure the accuracy of appliances. Therefore, a novel robotic system was developed for automatic and accurate preparation in our study. First, the implementation of hardware system was designed. Second, a modular and ROS-integrated control system was developed to control automatic bending. Third, an adaptive sampling-based bending planner with collision checker in a time-varying environment was established and realized in control system architecture. Preliminary validation of the developed robot system and its control system have been conducted both in simulation and physical robotic system. Experimental results have shown that the developed robotic system with its ROS-integrated control system was able to accomplish automatic and accurate orthodontic archwire preparation.**

Index Terms— **orthodontics, orthodontic archwire, robotic bending, motion planning and control, ROS**

I. INTRODUCTION

a key criteria for the development of a robotic system for orthodontic archwire bending.

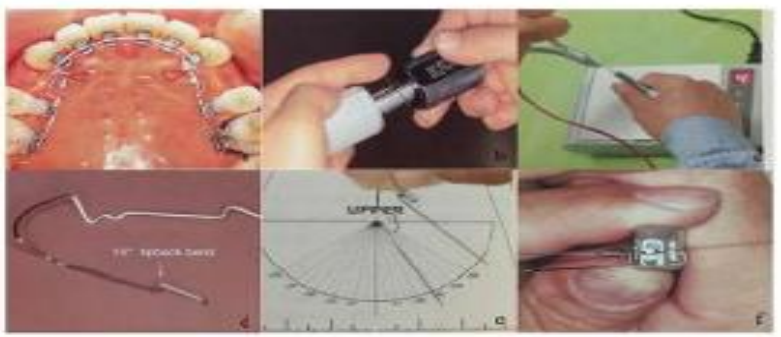


Fig. 1. Typical operations of manual orthodontic archwire preparation in the clinic[2, 3], only orthodontists with long-time clinical training are able to handle the manual preparation. (a) Appliance used in lingual orthodontic treatment, (b) basic arch forming using lingual arch former, (c) bends shaping of Ni-Ti wire using the electric heating treatment device, (d)

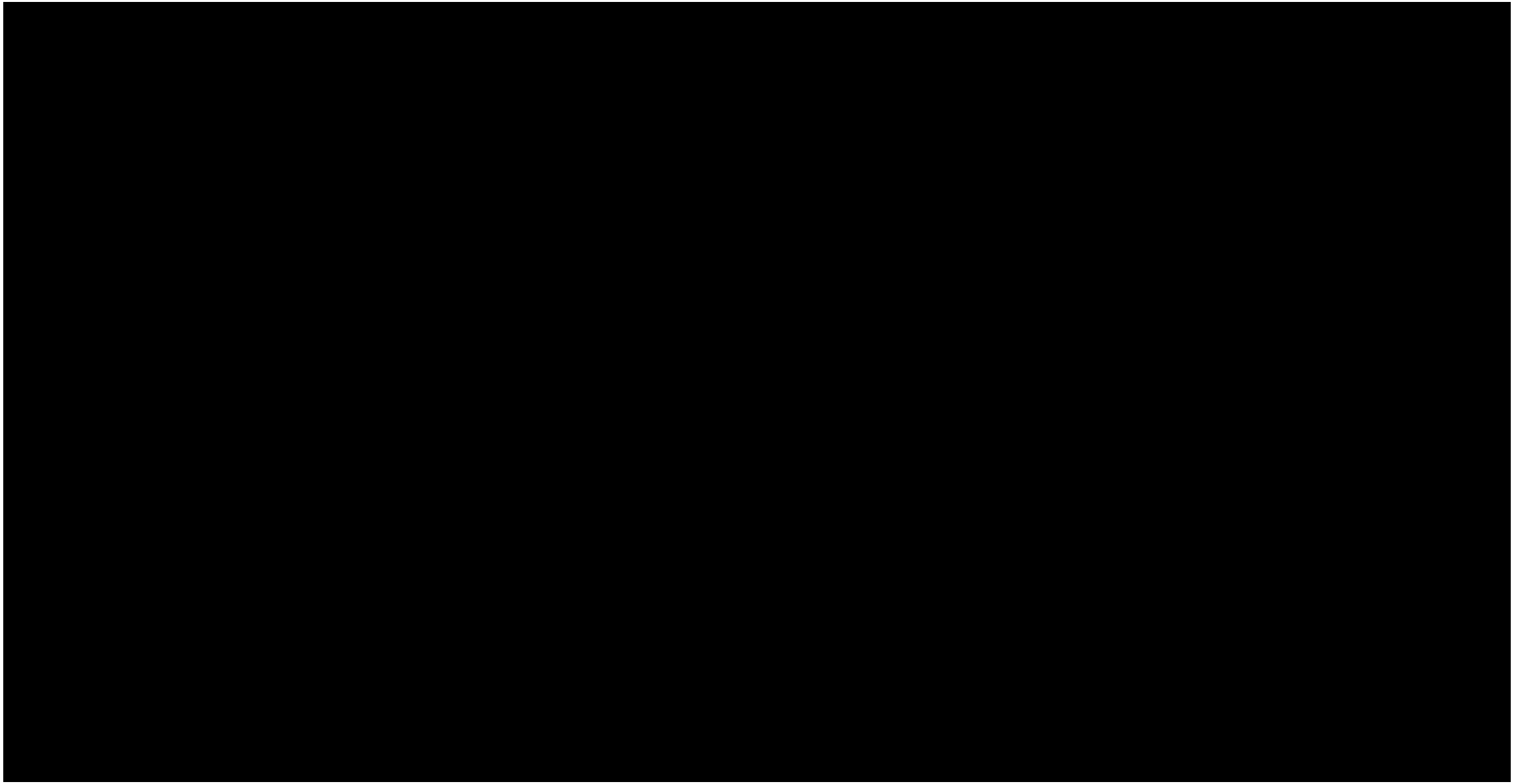
An In-Office Wire-Bending Robot for Lingual Orthodontics

ALFREDO GILBERT, DDS, MS

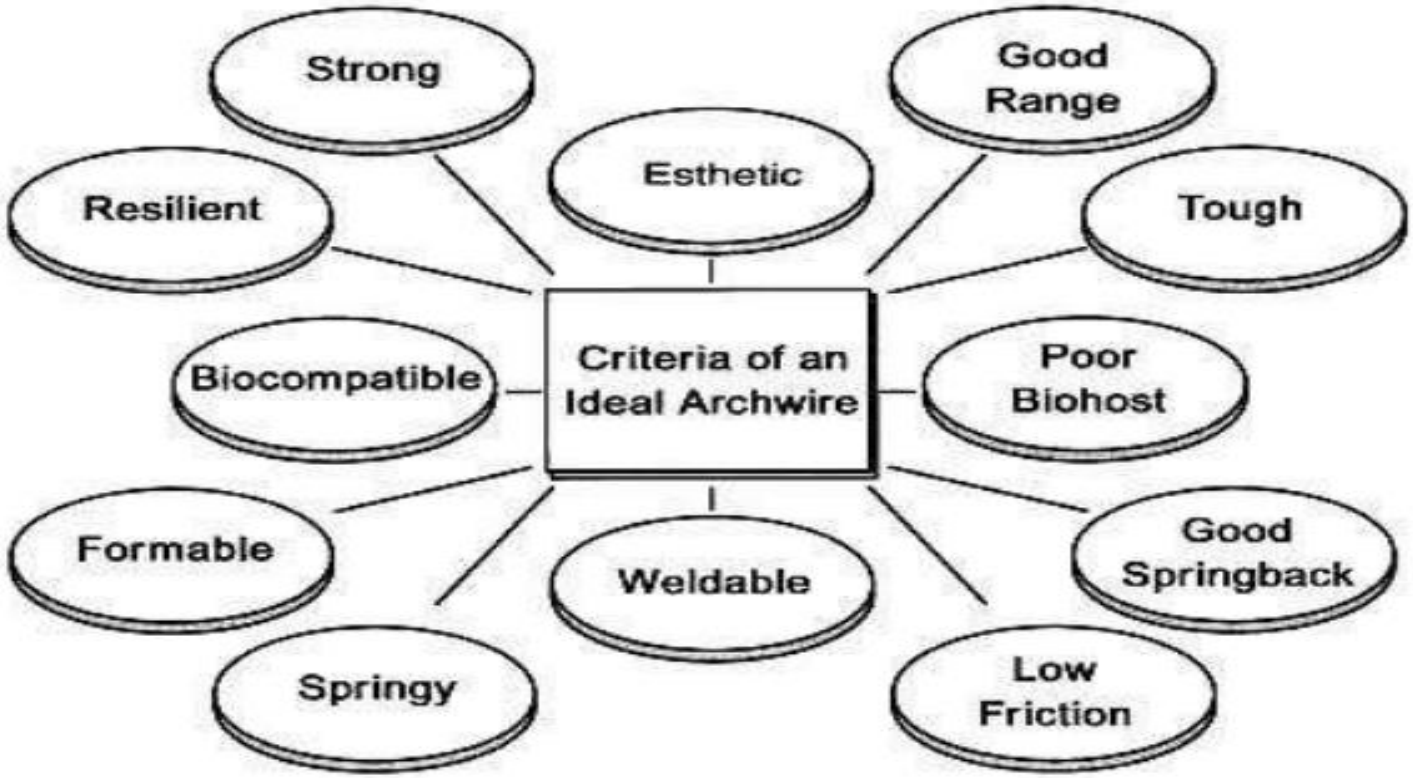
Although precisely made archwires are crucial to the success of lingual orthodontics, the irregular lingual dental anatomy and small interbracket distances make manual wire-bending difficult, especially in cases involving anterior crowding. Lingual archwires require numerous offsets, often asymmetrical,[1] and minor inaccuracies in wire design or manufacture can produce undesirable clinical consequences. For example, the distal bends of an overlong lingual archwire displace the buccal segment (Fig. 1).

This article introduces a system for designing and bending archwires more precisely and rapidly, called LAMDA* (Lingual Archwire Manufacturing and Design Aid, Fig. 2). The software was devel-

*Lancer Orthodontics, Inc., 2330 Cousteau Court, Vista, CA 92081; www.lancerortho.com.



IN SEARCH OF THE IDEAL ARCHWIRE..by Kusy



CONCLUSION

- It can be seen that there is not a single arch wire that meets all the requirements of the orthodontist. We still have a long way to go, in terms of finding the “Ideal archwire.” But, with such rapid progress being made in science and technology, I am sure that we will see significant improvements in arch wires in the near future specially the robotic one.
- Also, we must consider ourselves fortunate to have such a wide array of materials to choose from. Just imagine working with just a single type of Gold alloy wire, like they used to not so long ago. So we should appreciate this fact and try to make the most of what we have.

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Thanks for attention