JUVORA™
DENTAL INNOVATIONS

JUVORA™ Dental Disc

The Processing Guide

The Processing Guide

Instructions for Use and Safety Precautions:
The JUVORA™ Dental Disc shall only be processed in accordance with this manual and the instructions for use.

Qualifications and Safety at Work:
The user has to be trained and skilled in dental technology and know the safety regulations for the application.

JUVORA recommend the use of eye protection, extraction units and a dust mask as is applicable for all standard dental milling procedures.

IMPORTANT: This manual covers the use of products from the following companies:

- 3M ESPE
- GC
- Anaxdent

Other possible combinations can be found in the chart at the end of this manual.

Any systems not referenced in this manual MUST be fully tested according to ISO 11405 Dental Materials – Testing of Adhesion to Tooth Structure, and with a resultant adhesive strength of >10 MPa.

Indications

For the manufacture of frameworks used in the production of:

i. Full and Partial removable dentures and Overdentures;

ii. Implant dentures and implant bars;

iii. Anterior and posterior crowns, and posterior 3-unit bridges (maximum 1 pontic)

Contents

This manual describes:

- Preparation of the Model
- Construction and Design Guidance – per Application
    1. Implant Dentures
    2. Implant Bars
    3. Overdentures
    4. Clasp Dentures
    5. Attachment Dentures
    6. Telescope Dentures
    7. Crowns & Bridges
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- Milling of the JUVORA™ Dental Disc
- Cutting out the prosthesis
- Positioning of the teeth
- Recommended Surface Preparation
- Application of Silane and Preparation of Pre-Manufactured Teeth
- Application of the Foundation Opaque
- Application of Coloured Opaque
- Dentine and Gingiva Flow – Application of Pre-Manufactured Teeth
- Veneering a Tooth
- Corrections
- Other Veneering Systems

Not all sections of this manual are applicable to all indications.

Preparation of the Model

Suggestions for Model Preparation:

Scanning Model:
The model for scanning can be made from gypsum and should have no reflective surface.

Veneering Model:
The model for veneering can be made from transparent acrylic.

Wax Model Construction:
Block out with wax – **AVOID** sharp edges. This makes it easier to fit the denture to the model after construction.

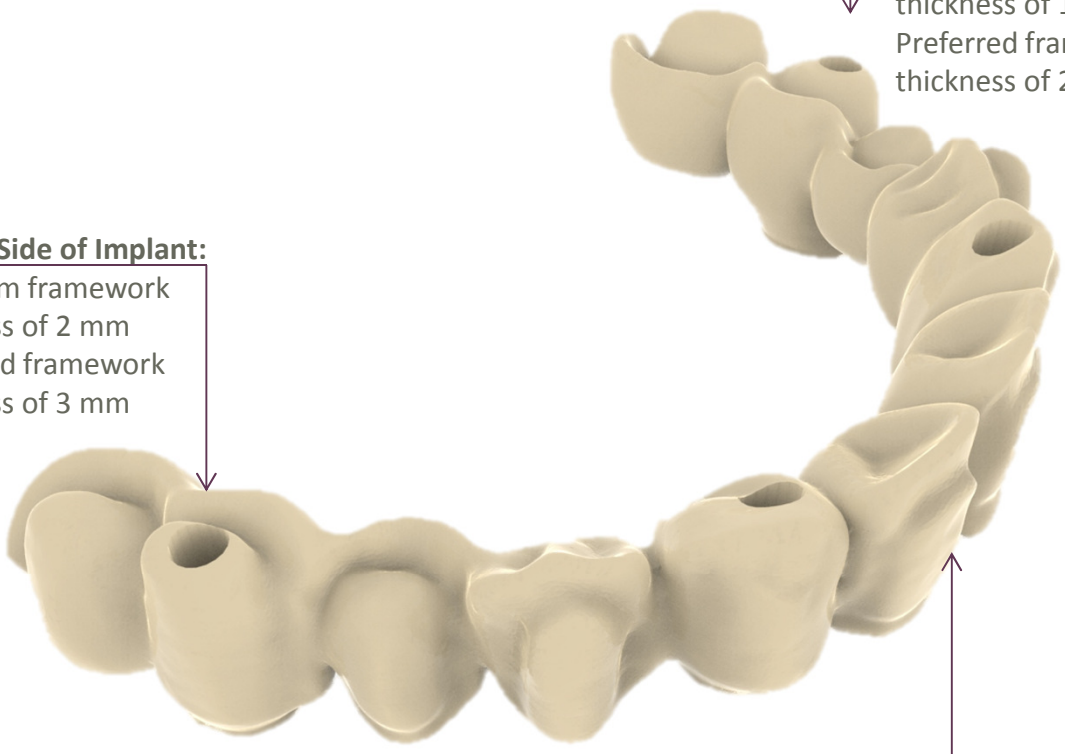
Scanning Considerations:
To achieve detailed scanning results:
Use high resolution.
A good polygon mesh (at least 1 million) is required as less than this will lead to inaccuracies.

Construction and Design Guidance Per Application

Implant Dentures

Buccal Side of Implant:
Minimum framework thickness of 1.5 mm
Preferred framework thickness of 2 mm

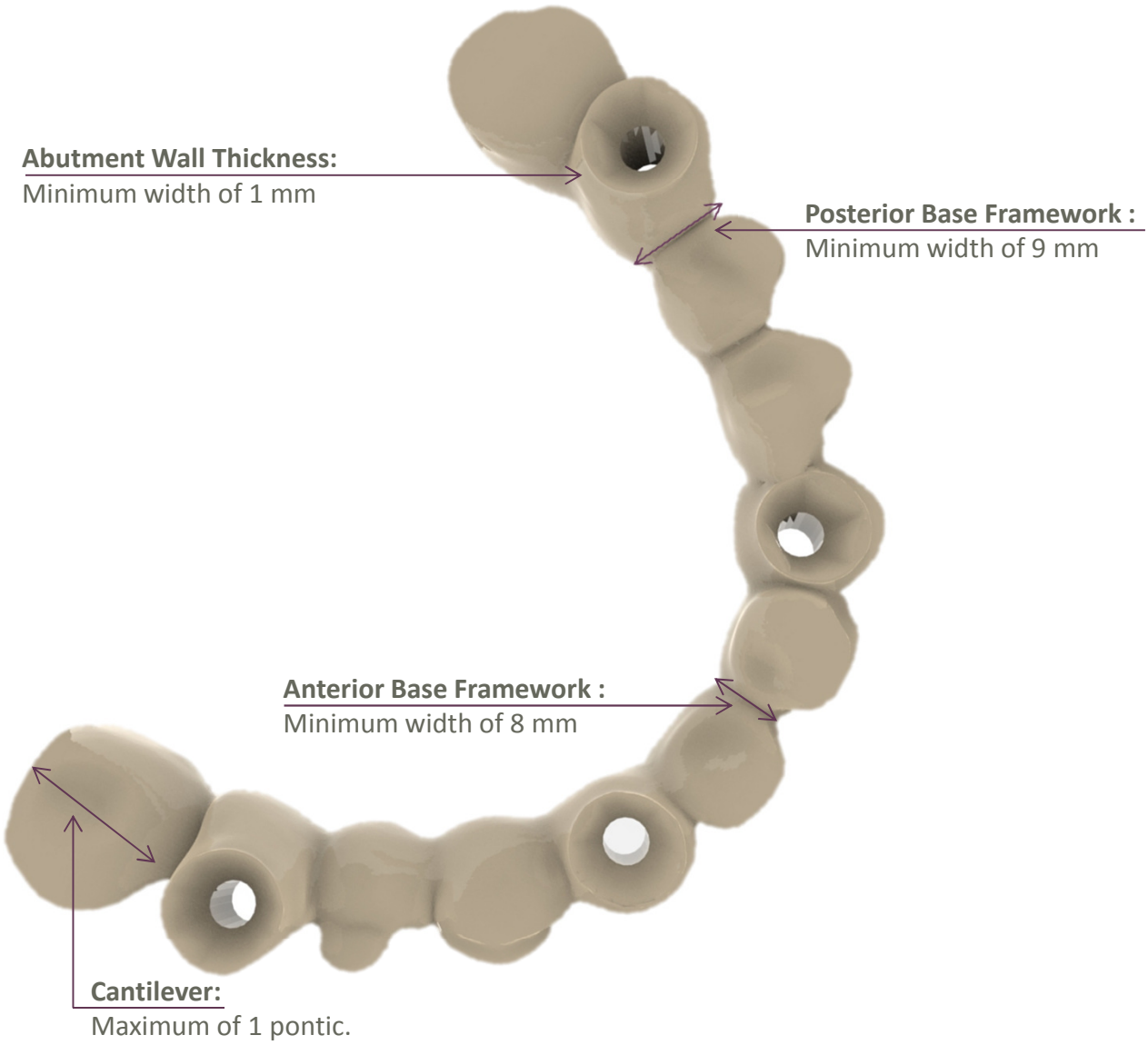
Lingual Side of Implant:
Minimum framework thickness of 2 mm
Preferred framework thickness of 3 mm



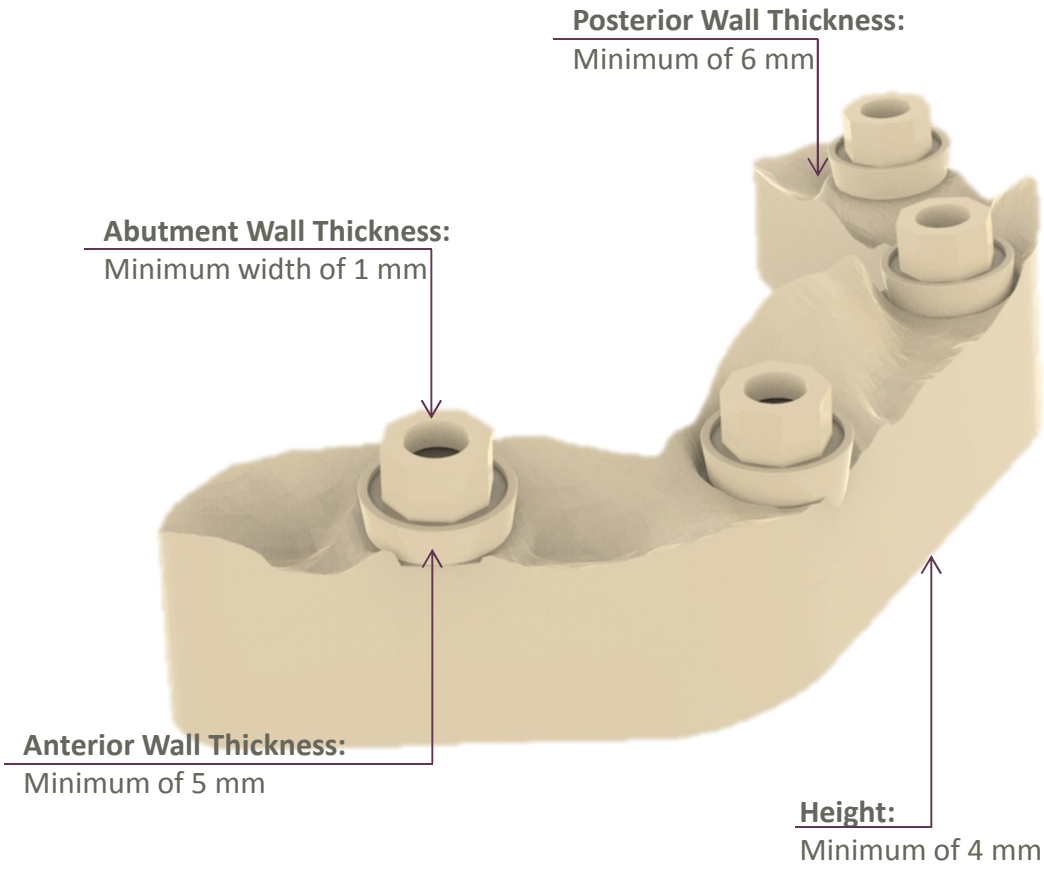
Height of Framework:
Minimum framework height of 5 mm
Preferred framework height of 7 mm to 10 mm to improve bonding

Palatinal Plate Protection: Required to avoid damage/de-bonding between the framework and the veneering. Where possible avoid contact between the veneer and the antagonist and ensure contact in the anterior region of the Juvora framework.

Implant Dentures



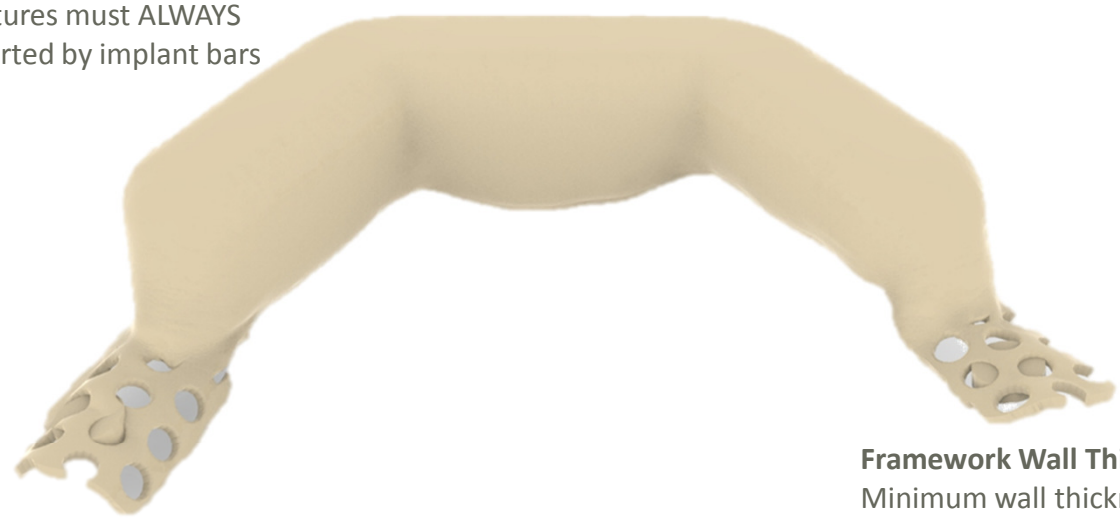
Implant Bars



Attachment Piece (if using):
To secure the attachment piece onto the framework attachment housing please use the primer bonding system recommened in the veneering table at the end of the document : Page 29

Overdentures

Implant Bar:
Overdentures must ALWAYS be supported by implant bars



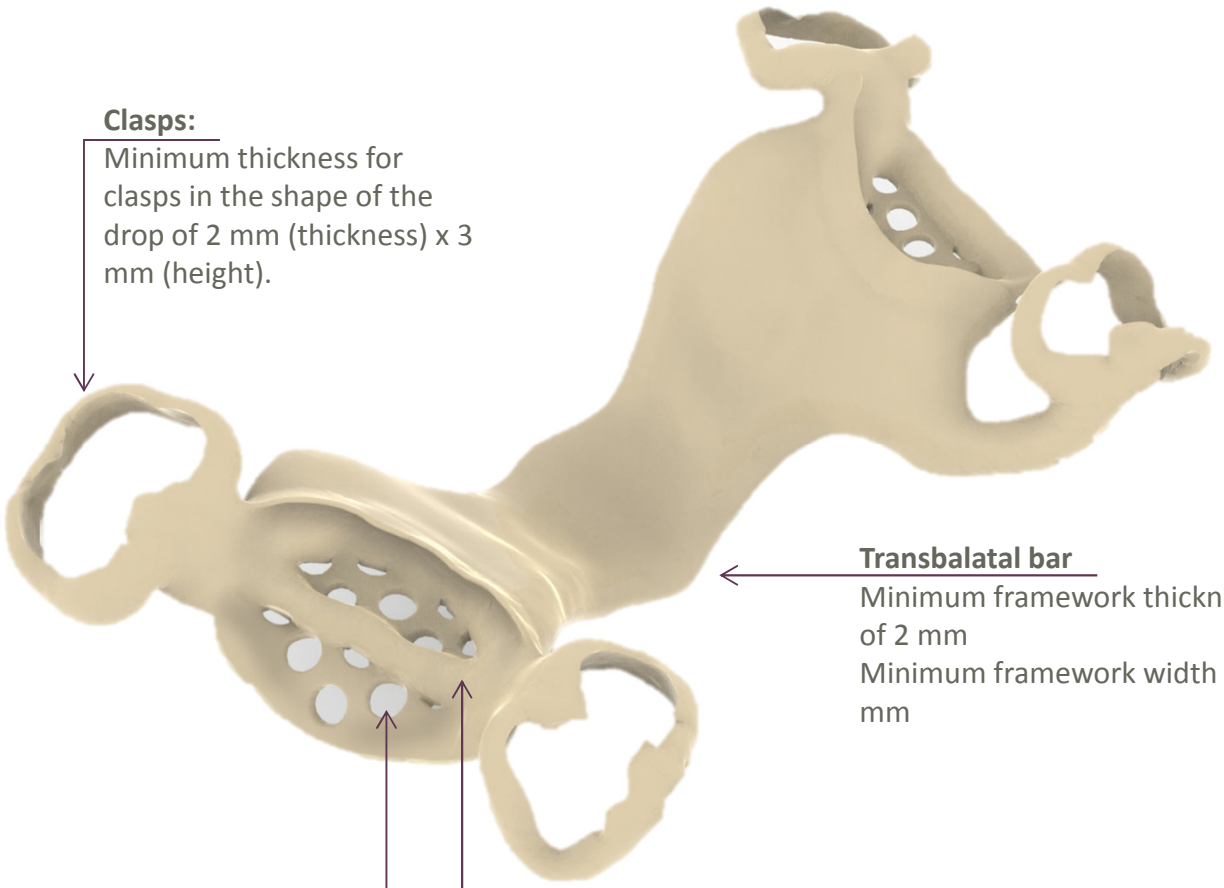
Framework Wall Thickness:
Minimum wall thickness of 2 mm on occlusal, lingual and buccal regions

Protection Plate:
A Palatinal or Lingual protection plate is required for overdentures when a transpalatal bar (horizontal retainer) is not present

Attachment Piece:
To secure the attachment piece onto the framework attachment housing please use the primer bonding system recommended in the veneering table at the end of the document : Page 29

Palatinal Plate Protection: Required to avoid damage/de-bonding between the framework and the veneering. Where possible avoid contact between the veneer and the antagonist and ensure contact in the anterior region of the Juvora framework.

Removable Clasp Dentures



Clasps:
Minimum thickness for clasps in the shape of the drop of 2 mm (thickness) x 3 mm (height).

Transbalatal bar
Minimum framework thickness of 2 mm
Minimum framework width of 8 mm

Retention Plate Holes:
Maximum hole diameter of 2 mm
Minimum distance between hole and external plate wall of 1 mm
Minimum distance between adjacent holes of 2 mm

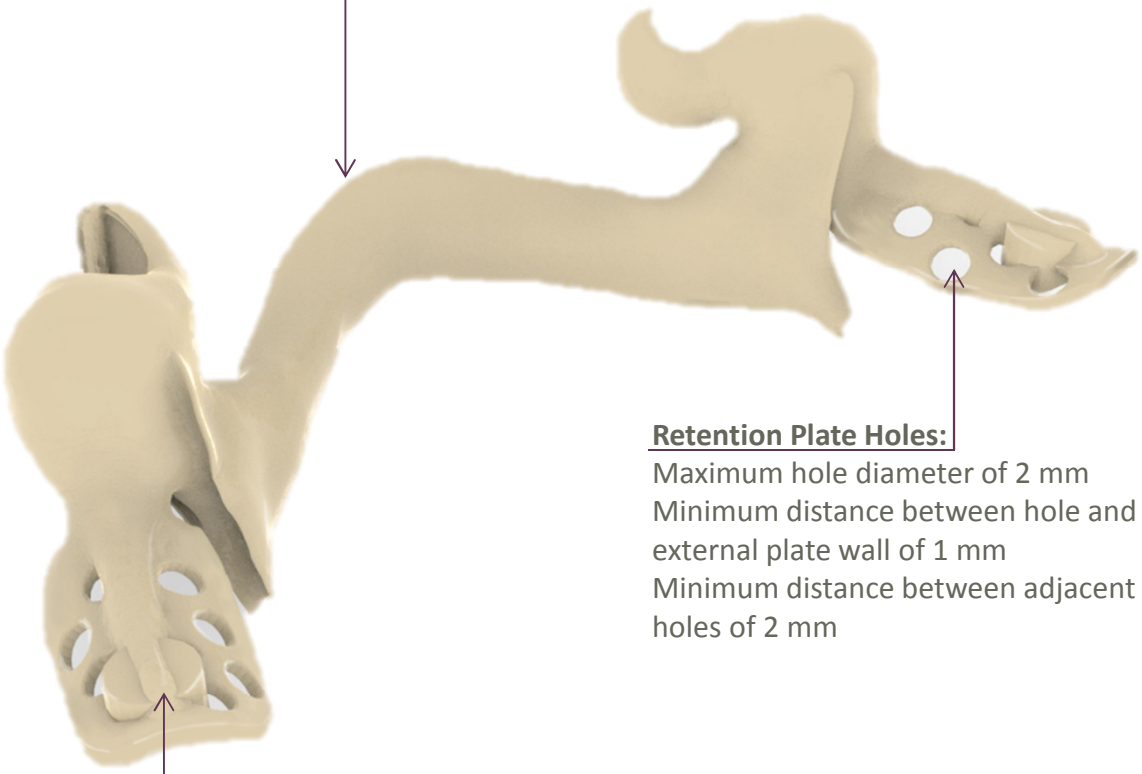
T-Shape Reinforcement:
Required to provide strength and stability.
Minimum diameter: 1.5 mm^2

Machining Tip:
For higher stability whilst milling the clasps have to be connected with each other or with the framework. Double closed clasps can be used.

Removable Attachment Dentures

Retention Grooves:
Must have a smooth finish, round curvature and no indentations and sharp edges.
Minimum width of 2 mm, minimum height 1.5 mm.

Lingual bar:
Minimum framework thickness of 2 mm
Minimum framework width of 8 mm



Retention Plate Holes:
Maximum hole diameter of 2 mm
Minimum distance between hole and external plate wall of 1 mm
Minimum distance between adjacent holes of 2 mm

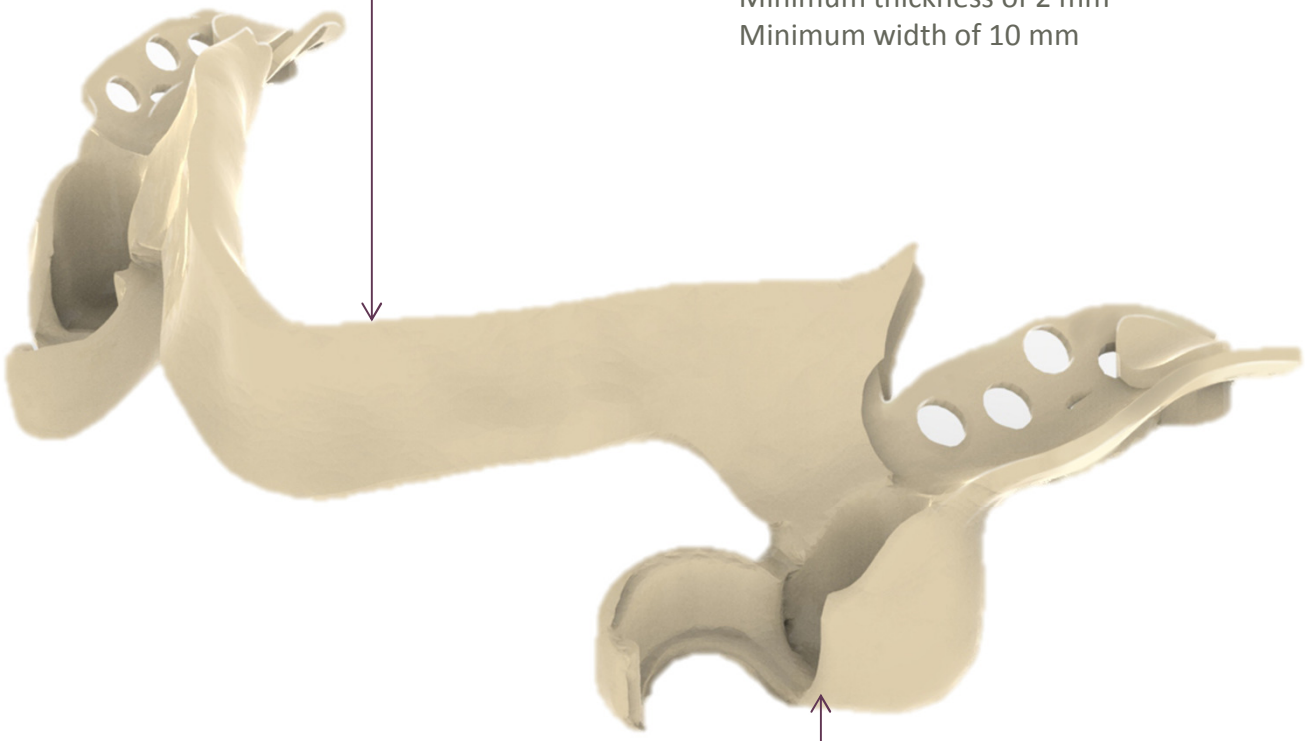
T-Shape Reinforcement:
Required to provide strength and stability.
Minimum diameter: 1.5 mm^2

Attachment Piece:
To secure the attachment piece onto the framework attachment housing please use the primer bonding system recommended in the veneering table at the end of the document : Page 29

Removable Attachment Dentures

Lingual Bar (lower):
Minimum thickness of 2 mm
Minimum width of 5 mm

Transpalatal Bar (upper):
Minimum thickness of 2 mm
Minimum width of 10 mm



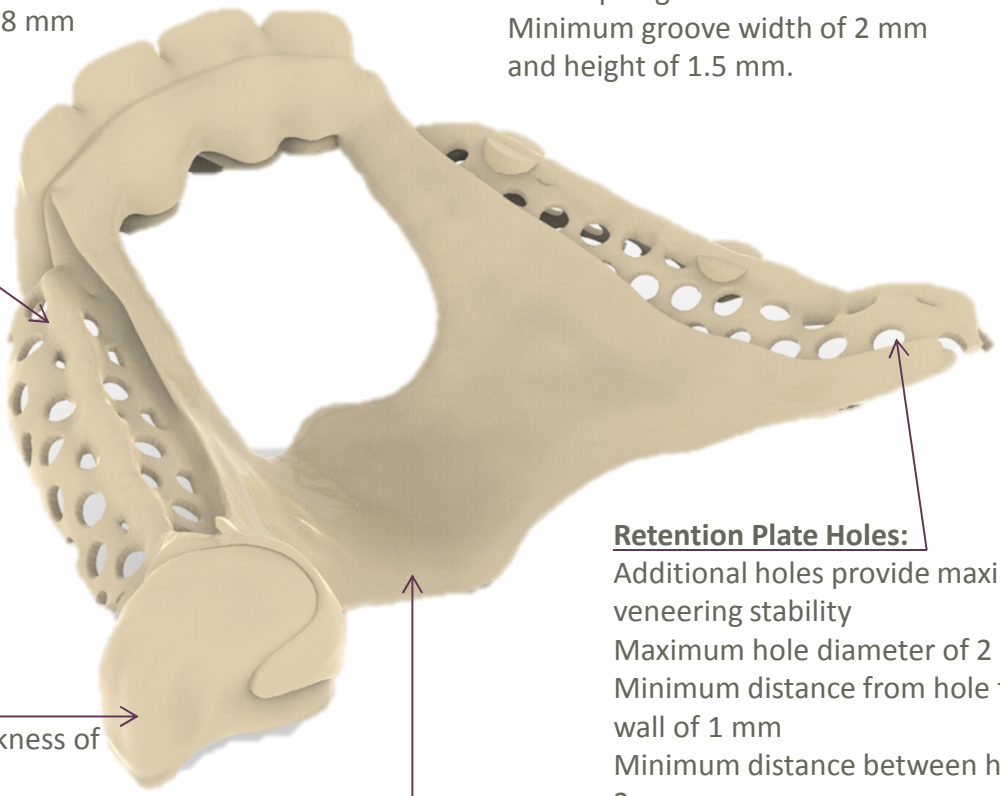
Connector Housing:
Wall thickness minimum for each area:
Occlusal : 1 mm EXCEPT in fully anatomic where thickness should be greater than 1.5 mm
Buccal: 2 mm
Lingual: 2 mm
Palatinal: 2 mm

Attachment Piece:
To secure the attachment piece onto the framework attachment housing please use the primer bonding system recommended in the veneering table at the end of the document : Page 29

Removable Telescope Dentures

Retention Plate Framework:
Minimum thickness of 2 mm.
Minimum width of 8 mm

Retention Grooves:
Must have smooth finish, round curvature with no indentations or sharp edges
Minimum groove width of 2 mm and height of 1.5 mm.



T-Shape Reinforcement:
Necessary to assure stability and strength of framework
Minimum diameter: 1.5 mm^2

Retention Plate Holes:
Additional holes provide maximum veneering stability
Maximum hole diameter of 2 mm
Minimum distance from hole to plate wall of 1 mm
Minimum distance between holes of 2 mm

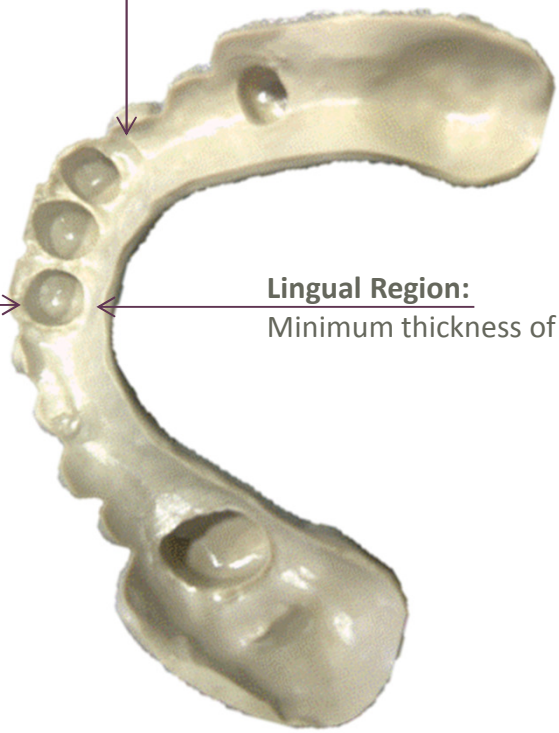
Occlusal Region:
Minimum wall thickness of 1.5 mm.

Transpalatal Bar:
Minimum thickness of 2 mm.
Minimum width of 10 mm

Removable Telescope Dentures

Lateral Region of Secondary Telescope Crown:
Minimum wall thickness of 2 mm

Wall Thickness Between Adjacent Secondary Telescope Crown:
Preferably greater than 1 mm thickness
Minimum thickness of 0.7 mm.



Buccal Area of Secondary Telescope Crown:
Preferably 1 mm thickness
Minimum thickness of 0.7 mm

Lingual Region:
Minimum thickness of 2 mm

Removable Telescope Dentures

Removable telescope dentures without transpalatal bar (horizontal retainer) – requires the designing of a palatinal protection plate (for upper jaw denture) or lingual protection plate for (for lower jaw denture).
Palatinal protection plate is required to avoid damage or de-bonding between the framework and the veneering. The antagonist should only make contact in the anterior region with the JUVORA™ material, and not at the juncture between JUVORA and the veneering material.

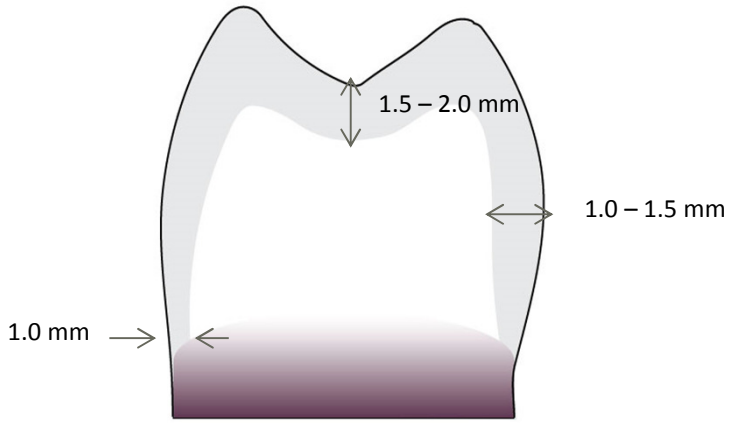
Palatinal/Lingual Protection Plate:
Contact with JUVORA framework recommended
AVOID contact with veneer

Crown & Bridge Master Table

JUVORA™ Framework	Anatomical Crown	Crown for Veneering	Anatomical Posterior 3-Unit Bridge – Maximum 1 Pontic	Posterior 3-Unit Bridge for Veneering – Maximum 1 Pontic
Minimum Wall Thickness - Circumferential	1 mm	0.7 mm	1 mm	0.7 mm
Minimum Wall Thickness – Occlusal	1.5 mm	0.8 mm	1.5 mm	0.8 mm
Minimum Crown Margin	1 mm	-	-	-
Minimum Connector Dimension	-	-	16 mm^2	16 mm^2

Fully Anatomical Crowns

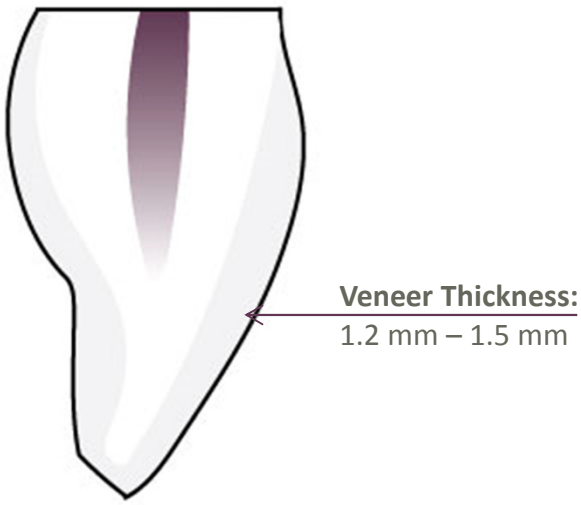
JUVORA™ PEEK framework	Anatomical crown
Minimum wall thickness circumferential	1 mm
Minimum wall thickness occlusal	1.5 mm
Minimum Crown margin	1 mm
Connector dimension	-



Follow accentuated chamfer preparation – provides a larger material surface spreading the pressure to the preparation.
AVOID – Chamfer and Shoulder preparation as these will weaken the framework

Crowns for Veneering

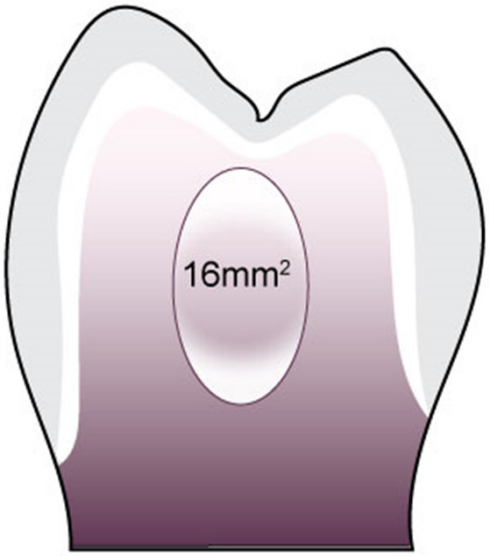
JUVORA™ PEEK framework	Crown for veneering
Minimum wall thickness circumferential	0.7 mm
Minimum wall thickness occlusal	0.8 mm
Crown margin	-



Fully Anatomical Bridge 3-Unit

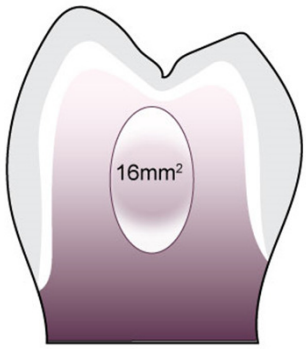
JUVORA™ PEEK framework	Anatomical Posterior 3-Unit Bridge – Maximum 1 Pontic
Minimum wall thickness circumferential	1 mm
Minimum wall thickness occlusal	1.5 mm
Minimum connector dimension	16 mm²

Posterior Connection Area:
Minimum of 16 mm²

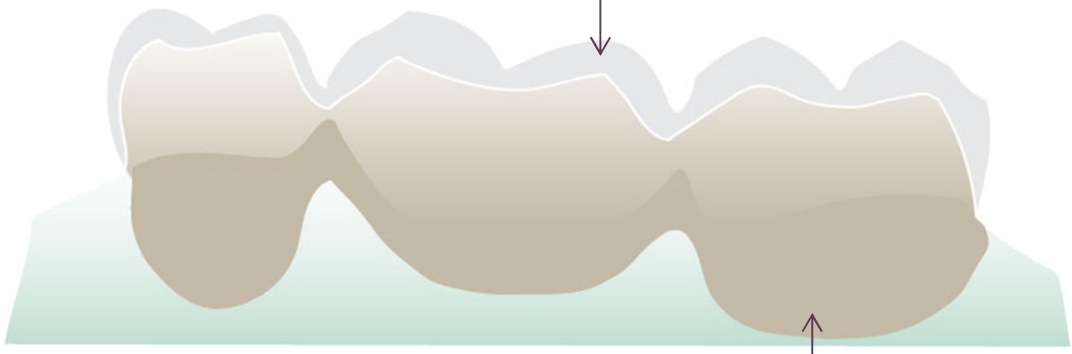


3-Unit Bridge for Veneering (Maximum 1 Pontic)

JUVORA™ PEEK framework	Posterior 3-Unit Bridge for Veneering – Maximum 1 Pontic
Minimum wall thickness circumferential	0.7 mm
Minimum wall thickness occlusal	0.8 mm
Minimum connector dimension	16 mm2



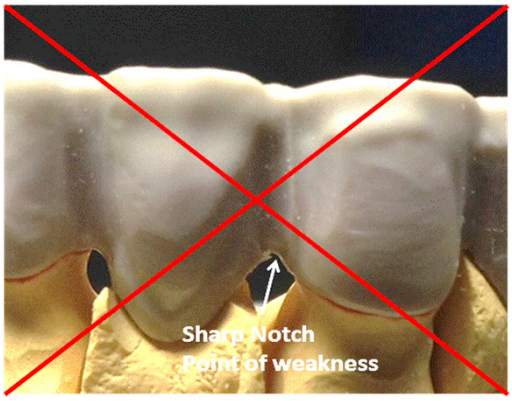
Veneer Area:
Does not exist in the framework



Cusp Reinforcement and Pontic Basal Area:
MUST NOT be veneered.
High polish only

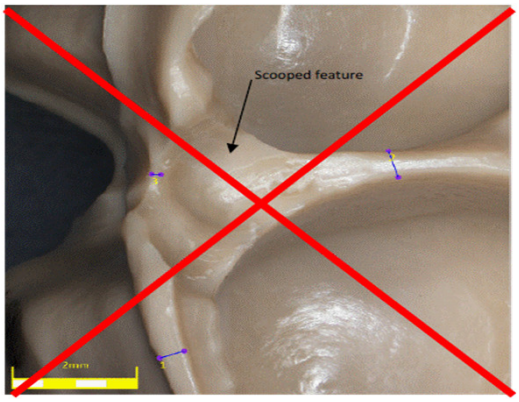
Design Guidance: 3-unit bridge frameworks MUST be constructed in anatomically reduced design with reinforcing the composite cups.
When veneering the frameworks the pontic basal area MUST NOT be covered with the veneering material.

Important Design Considerations for JUVORA Frameworks



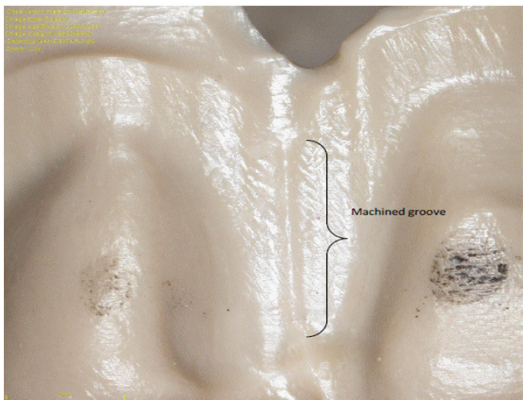
Notches in Framework:
Where possible **AVOID** introducing notches into the JUVORA framework. Creating a notch creates a point of weakness within the framework.

If unavoidable notches must not be present on areas with a thickness less than 2 mm and **must have an angle greater than 45 degrees.**



Scooped Features:
Scooped features can weaken the JUVORA framework.

ENSURE that such a feature is not adjacent to a thin wall thickness.



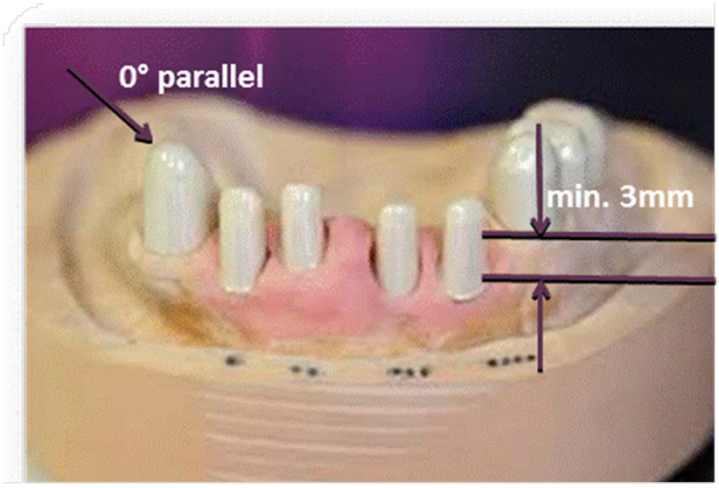
Grooves:
Groove features can act as stress concentrators and can weaken the JUVORA framework.

ENSURE that such a feature is not adjacent to a thin wall thickness.

Key Design Focus:
If the guidance on framework design with regard to avoiding introduction of notches and/or minimum wall thickness is not followed, then failure can occur.

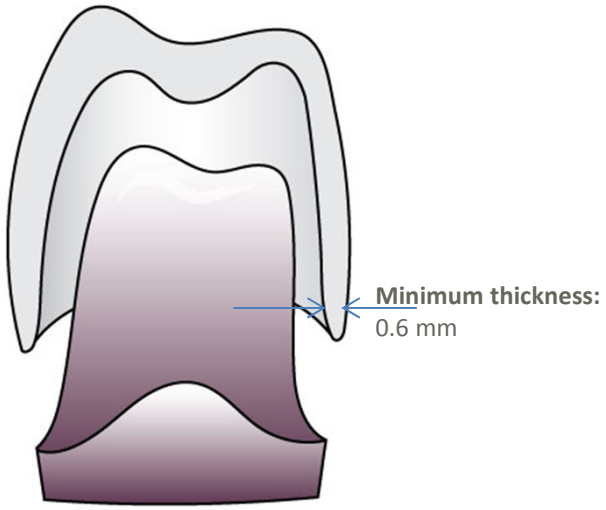
Recommendations Regarding the Construction of Collateral Parts

Construction:
Primary Parts: Primary telescopes and attachments
Parallelism: **0° parallel**
No cone
Height of the friction: **minimum 3 mm**



Zirconium is recommended as the material for primary telescope crowns.

For the secondary telescope crowns produced from a material which is not JUVORA™ (for example gold) a **minimum wall thickness of 0.6 mm** is recommended.



Milling of the JUVORA™ Dental Disc

Machine Selection:
JUVORA Dental Discs can only be processed on suitable milling machines with suitable milling programs. JUVORA recommends adaptation of the CAM software by your software manufacturer. For an exact fit, JUVORA recommends a 5-axis milling machine of stable construction.

Cooling:
JUVORA recommends cooling the milling head either with compressed air or cooling fluids.

Time Taken:
Milling time should be approximately 2 hours depending upon size and design

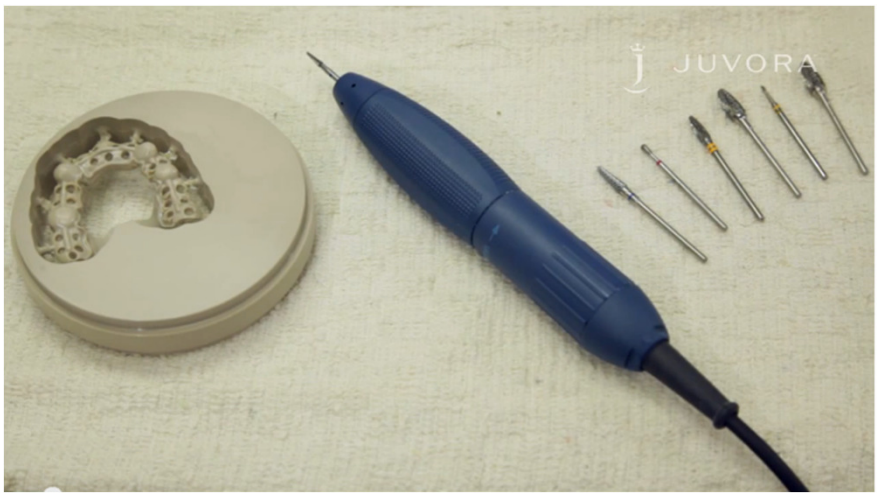
Tool Speed:
It is advisable to keep tool speed above 15,000 rpm to avoid heat generation on the surface of the disc. Operating at lower tool speeds may lead to stresses which in turn can cause dimensional inaccuracies, problems with patient fit and potential framework failure under loading.

Tool Selection:
JUVORA recommend the use of silicon carbide or diamond tipped tooling.

Milling Machine Set-Up			
Special Instructions	**Use a 5-axis milling machine to enable a milling angle of 15°**	**Use silicon carbide or diamond tipped tooling**	**Use diamond tipped tooling**
Clearance Angle (°)		5 – 15	15 – 30
Rake Angle (°)		6 – 10	6 – 10
Cutting Speed (m/min)		Up to 15,000	Up to 15,000
Coolants		Compressed air	Compressed air
Feed may be up to 0.5 mm/tooth			

Cutting Out the Prosthesis

1) Upon removal from the milling machine - carefully remove the connection bars with a fine bur



2) We recommend the use of grinding instruments which are suitable for soft materials

3) Closed retention holes can be opened with a fine bur

Positioning of the Teeth

1) Use modelling wax to hold the teeth *in situ*. Teeth will be veneered later (Veneering of the teeth is explained in the veneering section).

2) Application of the transparent silicon aids fixation of the teeth during light curing.

Recommended Surface Preparation

1) Sandblasting of the framework (Rocatec plus, **pressure: 3 bar, distance: 1 cm**), please see manufacturer's guidance.

2) Sandblasting of the teeth with Aluminium Oxide – **pressure: 3 bar, distance: 1 cm.**

Application of Silane and Preparation of Pre-Manufactured Teeth

1) In this manual the silane 3M ESPE Sil is used.

2) A thin application of silane is recommended. Drying time should be between 5 to 30 minutes maximum.

3) The teeth are then glued to the silicone ready for veneering.

Application of Foundation Opaque

1) Apply the Foundation Opaque thinly and evenly to avoid “puddles”.

2) Polymerisation of the opaque
   Time of polymerization of the opaque: **3 Minutes**
   Wavelength for polymerization: **380 to 450 Nm**

3) After polymerisation a smooth, shiny surface should be achieved. In case of insufficient coverage add another layer.

Application of Colored Opaque

1) Apply the **pink** colored opaque thinly and evenly in 2 layers to avoid “puddles”.

2) Apply the **tooth** colored opaque thinly and evenly in 2 layers to avoid “puddles”.

3) Polymerization of the opaque
   Time of polymerization of the opaque: **3 Minutes**
   Wavelength for polymerization: **380 to 450 Nm**

4) After polymerisation a smooth, shiny surface should be achieved.

Dentine and Gingiva Flow – Application of Pre-Manufactured Teeth

1) The dentine flow should be applied to the model (framework and teeth in silicone) initially from the occlusal side followed by a short polymerization.

2) The gingiva flow is then applied from the buccal side (following removal of silicone) followed by a short polymerization.

3) Apply the Air Barrier and complete a final polymerization according to the thickness of the layer (5 to 10 minutes).

Veneering a Tooth

1) Sandblasting of the framework (Rocatec plus, Presure: 3 bar, Distance: 1 cm). Please see Manufacturer's advice

2) Apply a thin layer of 3M ESPE Sil silane.
   Drying time: 5 to 30 Minutes max.

3) Apply the Foundation Opaque thinly and evenly.
   Time of polymerization: 3 Minutes

4) Apply the tooth colored opaque thinly and evenly in 2 layers to avoid "puddles".
   Time of polymerization: 3 Minutes.

5) Apply opaque dentine using the spatula technique. Do not use any fluid.

6) Apply the opaque O-dentin with a brush, wetting the brush lightly with composite primer. Follow with a short polymerization.

7) Apply the dentine using a brush to modify the shape, wetting the brush lightly with composite primer. Follow wit a short polymerization.

8) Apply the enamel and modify the final shape. Follow with a short polymerization.

9) Apply the Air Barrier and complete a final polymerization according to the thickness of the layer (5 to 10 Minutes).

Corrections

1) Sandblast using Aluminium oxide. Pressure: 3 bar, Distance: 1 cm.
2) Steam clean
3) Apply the composite primer.
4) Light cure for 5 Minutes
5) Apply the required material depending upon the correction.
6) Short Polymerization.
7) Repeat steps 5 and 6 as required.
8) Final polymerization: 5 to 10 Minutes.

Other Veneering Systems

System	Surface Treatment	Bonding Primer	Opaque Paste	Dentin Veneer	Shear Bond Strength (MPa) – After 90 days aging
GC Gradia	Al_2O_3/2 bar/50 µm	Bredent, Visiolink	GC opaquer	GC Gradia	27.3
3M ESPE, Sinfony	3M ESPE, Rocatec Pre, Plus	3M ESPE, ESPE Sil	3M ESPE, Sinfony	3M ESPE, Sinfony	27.1
Bredent/Visioline	Al_2O_3/2 bar/50 µm	Bredent, Visiolink	Combo lign	Crea.lign	24.2
Shofu, Ceramage	Al_2O_3/2 bar/50 µm	ML Primer	Pre/Opake	Shofu, Ceramage	21.1
GC Gradia	3M ESPE, Rocatec Plus	3M ESPE, ESPE Sil	GC opaquer	GC Gradia	21.0
GC Gradia	Al_2O_3/2 bar/50 µm	GC Metal primer II	GC opaquer	GC Gradia	19.6
3M ESPE, Sinfony	3M ESPE, ocatec Plus	3M ESPE, ESPE Sil	3M ESPE, Sinfony	3M ESPE, Sinfony	19.6
Ivoclar, SR Adoro	Al_2O_3/2 bar/50 µm	Ivoclar, SR Link	Ivoclar, SR Opaquer	Ivoclar, SR Adoro	17.9
Heraeus Kulzer/Signum	Al_2O_3/2 bar/50 µm	Metallbond I and II	Opaquer F	Heraeus, Signum	14.6
Shofu, Solidex	Al_2O_3/2 bar/50 µm	Shofu, Photo Primer	Shofu, Flow Opaquer	Shofu, Solidex	14.3
3M ESPE, Clearfill/Sinfony	Al_2O_3/2 bar/50 µm	Clearfill, Alloy Primer	Clearfill, Opaquer	3M ESPE, Sinfony	13.0
Schuetz, A+B Composite	Al_2O_3/2 bar/50 µm	Schuetz, Bonding Fluid	Schuetz, Paste	Schuetz, A+B Composite	12.7
Heraeus, Signum	Al_2O_3/2 bar/50 µm	Heraeus, Signum Connector	Heraeus, Opaquer	Heraeus, Signum	11.7

Cement guidance

System	Surface treatment	Bonding primer	Cement	Shear Bound Strength after 90 days ageing (Mpa)
RelyX Ultimate **3M ESPE**	Al2O3/2 bar/50µ	Scotchbond Universal Adhäsiv, 3M ESPE	RelyX Ultimate 3M ESPE	21,2
RelyX Unicem **3M ESPE**	Al2O3/2 bar/50µ	Scotchbond Universal Adhäsiv, 3M ESPE	RelyX Unicem 3M ESPE	20,6
Variolink II, **Ivoclar-Vivadent**	Rocatec Pre, 3M ESPE	Heliobond Ivoclar-Vivadent	Variolink II, Ivoclar-Vivadent	No decementation were observed with a diverse range of frameworks

JUVORA Veneering Bound strength – Published evidence

Feedback

Clinical Oral Investigations
August 2014

Date: 06 Aug 2014

Shear bond strength between veneering composite and PEEK after different surface modifications

Martin Rosentritt, Verena Preis, Michael Behr, Nuno Sereno, Carola Kolbeck

RESULTS: Surface roughness varied between 0.04 ± 0.01 and 6.76 ± 1.11 µm. Only etching caused a significant ($p < 0.001$) increase. SBS strongly varied between 0.0 ± 0.0 and 23.2 ± 2.1 MPa. After thermal cycling (TC), nine of the investigated systems showed SBS higher than 5 MPa, varying from 8.8 ± 2.7 MPa (#7) to 19.4 ± 2.5 MPa (#4). After water storage, nine systems provided SBS higher than 5 MPa, seven even values higher than 10 MPa. Maximum SBS was 27.1 ± 3.1 MPa (#2) and lowest value was 5.4 ± 2.6 MPa (#4). Significant ($p < 0.001$) differences were found between the individual systems after 24 h, TC and after 90 days storage.

CONCLUSIONS: For good bonding between PEEK and composite, cleaning and roughening is recommended. Surface conditioning prior to bonding seems essential. Combination with opaque revealed an increase in SBS.

CLINICAL RELEVANCE: Successful bonding on PEEK surfaces can be achieved by surface roughening and subsequent surface activation with acetone- or phosphate-based methacrylate primers or tribochemical treatment.

JUVORA Veneering Bound strength – Published evidence

IADR
International Association for Dental Research

77 Shear bond strength between composite and PEEK after surface modifications

Thursday, September 11, 2014: 10:45 a.m. - 12:15 p.m.
Location: Elafiti 4 (Valamar Lacroma Hotel)
Presentation Type: Oral Session

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Objective: The aim of this study was to test the influence of different surface treatments and conditioning methods on the shear bond strength values between polyetherketone (PEEK) and veneering composite.

Method: 570 PEEK plates (3x30x10mm; Juvora dental disc, Juvora, UK) were milled. Surfaces were used untreated, etched (H_2SO_4 98%; H_2O_2:H_2SO_4 1:1), sandblasted or activated with Rocatec treatment. Surface roughness Ra was determined after different treatments. Cylinders of veneering composite (d= 5mm, height 4mm) were polymerized onto the PEEK surfaces. 18 different pre-treatment combinations with veneering composite were applied partly combined with opaque application. Shear bond strength (SBS) was determined following ISO TR 11405 after 24hrs, storage (37°C; 90d) or thermal cycling (12,000 cycles 5°C and 55°C). Mean and standard deviation were calculated and statistical analysis was performed with one-way ANOVA / Bonferroni (α=0.05).

Result: Surface roughness varied between 0.06+/-0.03µm (untreated) and 6.76+/-1.11 µm (H_2SO_4 98% 1min). Only etching caused a significant ($p<0.001$) increase of Ra. Shear bond strength (SBS) strongly varied between the individual systems with values changing between 0.0MPa and 23.2MPa after 24hrs. After thermal cycling (TC) eight of the investigated systems provided SBS higher than 10MPa. For most systems no significant changes were found in comparison to baseline data. Four systems showed an increase in SBS, whereas five systems lost bond strength with TC. After storage for 90 days seven systems provided SBS higher than 10MPa, one system even showed 27.1 MPa. Significant ($p=0.000$) differences were found between the individual systems after 24hrs, TC as well as after 90d storage.

Conclusion: For optimized bonding between PEEK and veneering composite, cleaning, roughening and surface conditioning is recommended. The application of opaque materials revealed an increase in SBS. Five of the tested systems - mainly including phosphate components - achieved clinically sufficient SBS.

Safety Information

While machining the JUVORA™ Dental Disc, the following safety precautions are recommended:

- Dust mask or dust extraction
- Personal protective equipment (eye protection, gloves)

Storage Information

The JUVORA Dental Disc should be stored in dry conditions and exposure to direct sunlight should be avoided. The PEEK-OPTIMA® polymer from which the JUVORA Dental Disc is made is stable and can be stored for an extended period (10 year shelf life). It has a working temperature range from cryogenic up to 250 °c and hence the storage temperature range for the JUVORA Dental Disc is any ambient temperature and humidity.

Additional Information

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