Clinical Evaluation of Fixed Partial Dentures with Cast Joined Pontics

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ABSTRACT

Introduction: It requires great skill and material selection to achieve proper solder joint. It is more difficult to perform when one is working with the base alloy. Similar joint can be achieved by cast joining. But no clinical evaluation has been described in the literature about this technique.

Objective: To evaluate the clinical success of cast joining in porcelain fused to base alloy fixed partial denture.

Materials & Method: The metal frameworks of long span fixed partial denture that did not fit satisfactorily during metal try-in were sectioned through pontics. The pontics were grossly reduced and designed to achieve mechanical interlocking. Then they were connected by self-cure acrylic resin in the patients' mouth after achieving proper fit. They were reinvested in casting rings and recasting was done. After further try-in, ceramic application were completed and cemented in patients' mouth. Marginal fit, cervical caries, mechanical strength and metal ceramic bond in joined areas were clinically assessed using Ryge Clinical Criteria.

Result: 15 patients were available for follow up. Each patient had worn the fixed partial denture for more than a year. When clinically assessed the marginal fits were acceptable. None of the patients had any cervical caries. None of the fixed partial denture had failed mechanically. There were no cases of ceramic fracture in the pontics areas.

Conclusion: Cast joining could be one of the alternative techniques of soldering and welding in fixed partial denture provided that the split is done through the pontic area and well designed to achieve maximum mechanical interlocking.

Key words: cast connector, cast joining, preceramic soldering, soldering

INTRODUCTION

The precise fit of fixed multi-unit dental prosthesis is considered very important in clinical Prosthodontics. Poor marginal fit of cast multi-unit restorations may hasten the onset of failure due to abutment caries.[1] To assure the fit of metal frameworks on abutments, a trail insertion is generally performed in a clinic. If any discrepancy is detected, sectioning and joining of metal frameworks are required.[2]

There are two common ways of joining metals in dentistry: soldering and welding. In soldering, an intermediate alloy or solder flows between and around, and unites the parts to be joined. While in welding, the parent metals to be joined are fused in the joint area.[3] In Prosthodontic practice soldering is more common.

Soldering base metal alloy is more technique sensitive as compared to the precious or semi-precious gold alloy. The high temperature joints are more difficult to produce because of problems with wetting the cast surfaces with the solder.[4] Wetting of the substrate metal by the filler metal is essential to produce a bond. However, spreading of a molten metal does not occur if an oxide layer is present on the surface of the substrate metal, because oxides have poor wettability characteristics.[1,5] The readily formed oxide layer in the base metal alloy is therefore a disadvantage during the process of soldering. So the flux (fluoride flux) is used

to dissolve the oxide layer. However, this flux appeared to be displaced by the intense heat. Therefore, high temperature solder joints display more oxide inclusion.[4,5]

When accurate relations of component parts of prosthesis are required, as in joining the components of a fixed partial denture (FPD), an investment soldering must be used. Soldering investments differ from casting investments in that they use fused quartz (the lowest thermally expanding form of silica as a refractory) to minimize setting and thermal expansion.[6]

In FPD, the component parts of prosthesis can be joined before or after ceramic bonding. If the components are joined before ceramic bonding then it is called preceramic soldering and if it is done after ceramic bonding then is called postceramic soldering. It requires high temperature solder for preceramic soldering to avoid sagging of the prosthesis in the joint during ceramic firing. But if the flow temperature of the filler metal is close to or above the solidus temperature of the substrate metal, alloying can take place through the welding process.[5] An alloy formed through this diffusion can have properties different from those of both the solder and substrate metal. Thus, the compatibility of the solder with the parent alloy and with ceramic, for both mechanical strength and proper metal ceramic bond, is of utmost importance. Though the results may differ, but there is an agreement that preceramic soldering is difficult; localized shrinkage porosity, voids, flux inclusion and other defects have been associated with base metal high temperature joint.[1, 2, 5]

Due to the difficulties with standardization, the success of the soldering process continues to rest on the skill and experience of the operator. Currently, in general dental practice, most would consider it as an emergency, rather than an elective procedure.

To avoid the uncertainties and variations associated with the presoldering procedures, Weiss and Munyon in 1980 proposed the cast joining technique.[7] Here a pontic is cut diagonally in half, and each half is prepared with large undercut channels. It is then stabilized on an occlusal index, the undercut areas are waxed to full contour, sprued, invested in casting ring, burned out and cast with new metal. Here the components are retained mechanically. But no clinical research has been performed to identify the long-term clinical success of this approach.[5] So the objective of this study was to slightly modify the pontic preparation to achieve stronger mechanical joint and then evaluate the clinical success of cast joining in porcelain fused to base alloy fixed partial denture.

MATERIALS AND METHOD

The metal framework of long span fixed partial dentures that did not fit satisfactorily in the patient's mouth during metal try-in were sectioned through the pontics with the help of 0.02 inch separating disc (Figure 1). Each half of the framework was tried in the patient's mouth individually. Cases in which fit of both the halves of the framework improved and were satisfactory were planned to join by cast joining. Others, in which the fit were unsatisfactory, were discarded and new castings were done.

To improve the mechanical bond between the segments, sectioned pontic was grossly reduced from buccal, lingual, occlusal and mucosal surfaces. Some reductions were also done around the connectors. This was done with the idea that a complete new layer of metal will wrap the pontic, improving the mechanical bond strength.

The segments were again fitted in the patient's mouth. Monomer and polymer of tooth color self-cure acrylic resin was mixed in a dapen dish in thin consistency. Then it was applied in between and around the gap, with the help of spatula. During setting of the acrylic, the framework was stabilized with fingers (Figure 2).

Figure 1: Framework after sectioning through a pontic

Figure 2: Joining the framework with acrylic in patients mouth

Figure 3: wax-up before casting

Figure 4: Sprue connected for casting

Figure5: Final prosthsis after cementation

After setting of the resin, the metal framework was retrieved from the patient's mouth. The acrylic resin joint was finished and shaped to the pontic shape. After reconfirming the fit in the patient's mouth it was then send to a dental lab for cast joining.

In the laboratory, the acrylic resin joint was sprued, invested, burned out and cast with the same alloy that was used during framework casting (Figure 3,4).

During the next appointment the framework was tried in the patient's mouth. The fit of the framework as well as the cast joint was evaluated. Then the metal framework was send back to the lab to complete ceramic application.

Finally, the porcelain fused to metal ceramic fixed partial denture was trialed, occlusal adjustment was done, and whenever necessary re-glazed, and then cemented with luting cement (Figure 5).

For the study on evaluation of marginal adaptation; Ryge Clinical Criteria[8] was used during try-in appointment, after cementation of fixed partial denture and during one year follow-up as specified in Table 1.

The cervical caries was evaluated with the modified US Public Health Service criteria[8] during one year follow-up.

Porcelain fracture and Mechanical failure of the fixed partial denture were visually examined with the help of an explorer.

The clinical research was done among the patients of KDCH & private practice during 2012 - 2013 January

Table 1: Clinical evaluation of restorations using modified Ryge criteria

Clinical evaluation of marginal integrity	
Alpha (A)	No visible evidence of crevice along the margins; no catch or penetration of the explorer.
Bravo (B)	Visible evidence of crevice and/or catch of the explorer; no penetration of the explorer.
Charlie (C)	Visible evidence of crevice and penetration of the explorer.
Clinical evaluation of recurrent carries	
Alfa (A)	There is no visual evidence of dark, deep discoloration adjacent to the restoration.
Bravo (B)	There is visual evidence of dark, deep discoloration adjacent to the restoration.

Alpha and Bravo margin restoration is acceptable; Charlie restoration is not acceptable and must be replaced.

RESULTS

In 30 cases cast joining was attempted. Out of which 25 were accepted; as the marginal adaptations during framework try-in improved and was acceptable. Others 5 were rejected as they failed to fit the abutments satisfactorily.

Marginal assessments conducted immediately after cementation of cast joined fixed partial denture was highly satisfactory. More than 60% scored Alpha according to the Ryge/USPHD system.

Table 2: Location and span of fixed partial dentures available for follow-up

Case No.	Location of FPD	Span of FPD	Abutments (FDI notation)	Duration(in months)
1	Anterior maxillary	Six unit	13 & 23	13
2	Anterior maxillary	Eight unit	14,13, 23 & 24	23
3	Posterior mandibular	Five unit	47, 44 & 43	14
4	Antero-posterior maxillary	Nine unit	13, 23, 25 & 26	15
5	Posterior maxillary	Five unit	17, 15 & 13	13
6	Posterior maxillary	Five unit	17, 15 & 13	13
7	Posterior mandibular	Four unit	33 & 36	12
8	Posterior mandibular	Three unit	46 & 44	13
9	Anterior mandibular	Six unit	33 & 43	13
10	Anterior maxillary	Six unit	33, 31, 42 & 43	14
11	Posterior maxillary	Five unit	17, 15 & 13	16
12	Posterior maxillary	Five unit	17, 15 & 13	15
13	Posterior mandibular	Four unit	33 & 36	13
14	Posterior mandibular	Three unit	46 & 44	17
15	Posterior mandibular	Five unit	47, 44 & 43	16
Total 15	**-**	**-**	**N=42**	**Mean 14.66 months**

Altogether 15 patients were available for follow up. Each of these patients' had worn cast joined fixed partial denture for more than a year. The mean duration was 14.66 months. Location, span and duration of the fixed partial denture along with the abutment teeth of all cases are presented in the Table 2.

During follow-up examination, margins around each abutment were evaluated. There were all-together 42 abutments in 15 cases. Most of the margins were supra gingival and equigingival. There were no cervical caries in any of the abutment tooth (Table 3).

On follow-up examination, none of these fixed partial dentures had failed mechanically. All dentures were intact and were functioning well. Under occlusal force on cotton gauge, there were no separation or movements in the cast connected areas.

There was no ceramic debonding/fracture around the cast joining areas. In one case there was porcelain debonding but it was in the abutment tooth quite far away from the cast joined area.

Table 3: Clinical evaluations of marginal adaptation and cervical caries during follow-up

Parameter	Alpha (%)	Bravo (%)
Marginal integrity (N=42)	28 (66.6%)	14 (33.4%)
Cervical caries (N=42)	42 (100%)	-

DISCUSSION

As compared to soldering and welding, cast joining is a very easy and less technique sensitive procedure. It does not require great skill and experience to perform this technique like soldering and welding. However it is very important to understand and design the undercuts and to shape the pontic properly to achieve rigid joint.

The flexural strength of the cast joined structure is stated to be the least as compared to one piece cast structure and soldered structure.[5, 9] Failure to achieve very rigid mechanical joint will not only lead to mechanical failure of the fixed partial denture but will also cause porcelain fracture even in slight movement. Weiss and Munyon in their study made a split through the pontic and made few grooves and undercuts with in the split surfaces. In the present study; after splitting through a pontic it was reduced from all aspects, and some reductions were also done around the connectors. The idea was that the pontic would be completely wrapped up by a new layer of alloy and thus the surface area of the joint would be increased. Because of the shape of the pontic with maximum area coverage, the joint was supposed to be very rigid and strong.[9, 10] But it was hard to implement this preparation, when the design of the pontic was sanitary.

In cast joining the same parent metal was used to join the sectioned parts of the fixed partial denture. It not only saved the extra cost of the specific solder recommended by the alloy manufacturer but also assured the same metal ceramic bond on the cast joined areas as it is in the rest of the part of the fixed partial denture. As the effect of solder on the bond strength between the solder and the porcelain is quite unpredictable, it is of great advantage to have the same parent alloy on the cast joined areas.

Fluoride flux is used during soldering base alloy to remove oxide layer and to facilitate flow and bond between the solder alloy and the parent alloy. In this study no flux was used, as the joint was purely mechanical. So, the possibilities of flux displacement or flux inclusion like in soldering are avoided.

Similarly, it is always recommended to use soldering investment material for investment purpose to minimize setting and thermal expansion. But in this study the regular casting investment material was used. Because of high setting and thermal expansion of casting investment material, we often encountered difficulties in reseating the framework even after cast joining, especially in long span cases where we had to recast the framework. Hence, it is advantageous to have a low expansion investment material for cast joining procedure.

CONCLUSION

Cast joining procedure is an easy alternative technique for joining the cast framework that did not fit well in the patient's mouth. Marginal fit can be highly improved after this procedure. If the sectioned pontic is designed properly, then the cast joined pontic can withstand masticatory forces as well as resist porcelain fracture; thus giving a satisfactory clinical result.

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