

Comparison of Quality of Life Studies between Endodontic Treatment and Single Tooth Implants

BY

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THESIS

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DEDICATIONS

This thesis is dedicated to my family, faculty and co-residents. To my husband, Jeremy, who has been a constant source of encouragement. I thank you.

To my loving and lovely boys, Micah and Max, who reminded me that if I was doing the certificate, why not push myself and get the Masters degree. You were so right.

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LIST OF ABBREVIATIONS

STI	Single Tooth Implant
RCT	Root canal therapy
OHIP	Oral Health Impact Profile
OHIP-14	Oral Health Impact Profile-14 abbreviated questionnaire of the original OHIP, which had 49 questions

SUMMARY

Clinical outcomes of root canal treatment (RCT) and single tooth implants (STI) have been well documented, although much less is known about patient preferences for these two treatment options. Two instruments designed to measure oral health quality of life, the Oral Health Impact Profile (OHIP-14) and the Semantic differential scale questionnaire, are available and have been shown to be valid and reliable.

The purpose of this study was to compare and assess the quality of life issues associated with RCT and STI therapy in an urban population. One hundred seventy three patients that received RCT and a permanent restoration between 2009 and 2012 at the UIC College of Dentistry and were due for a regular recall visit were invited to participate in this study. Thirty RCT patients agreed to participate in the study. Fifty-three patients that received a STI and a permanent restoration between 2009-2012 at the UIC College of Dentistry and were due for a regular recall visit were invited to participate in this study. Twenty-nine STI patients agreed to participate. After informed consent was obtained, the subjects that chose to participate completed two questionnaires to assess satisfaction with various aspects of treatment and quality of life, the modified OHIP-14 and a Semantic Differential Scale.

Overall, patients at UIC COD that have had RCT or STI completed in a post-graduate department and restored in a predoctoral clinic were very satisfied with their treatment. Of the 29 STI patients and 30 RCT patients questioned in this research project, RCT patients felt that their treatment was less time consuming

than STI patients. On the modified OHIP-14 questionnaire, both RCT and STI patients reported that they never or hardly ever experienced the fourteen potentially negative aspects of treatment. RCT patients had more trouble pronouncing some words than STI patients, felt that their sense of taste had worsened, found it more uncomfortable to eat some foods than STI patients, felt tense because of problems with treatment, had a diet that had been unsatisfactory because of treatment more than STI patients, found it difficult to relax more than STI patients, and had difficulty doing usual jobs more often than STI patients. However, both STI and RCT patients were extremely satisfied with treatment.

In conclusion, there was not a significant difference in oral health quality of life between patients receiving RCT or STI. This study is a first step in helping to clarify quality of life issues that are most significant to patients receiving either RCT or STI treatment.

1. INTRODUCTION

1.1. **Background**

The term “quality of life” first was used in the 1920s, but it was not discussed in the North American literature until the 1960s (Wood-Dauphinee 1999). The development of generic measures began in the early 1970s and continues today. Disease-specific measures have also proliferated. The 1980s and 1990s saw an increase in methodological rigor, and additional emphasis on analytic approaches, interpretation of scale scores, cultural and language issues, as well as on the development of shorter measures (Wood-Dauphinee 1999).

Quality of life research began in dentistry, when Locker introduced a conceptual framework for these types of studies in 1988 (Locker 1988). These instruments assess the impact on quality of life of a variety of oral conditions and treatments, such as periodontal disease, tooth loss, and dental implants (Slade 1994).

1.2 **Significance of the Study**

This study directly compares patient satisfaction with endodontic and implant treatment. Often these treatment modalities are compared from a dental practitioner’s perspective. For example, treatment decisions may be based on outcome studies, financial considerations, and/or the clinicians experience and skill with certain procedures. This study attempts to evaluate the treatment from a patient’s point of view. Quality of life studies allow dental providers to assess many factors that may affect a patient’s overall satisfaction with a specific treatment

modality. The prudent practitioner would like to tailor treatment to give patients the highest quality of life possible. This study aids dentists in reaching this goal.

The data presented from the current study opens an opportunity for further studies.

1.3 **Specific Aims**

The purpose of this study was:

- (a) To compare and assess the quality of life issues related to RCT and STI therapy in an urban population.
- (b) To improve our understanding of the quality of life issues that are most relevant to patients receiving RCT and STI treatment.

1.4 **Hypothesis**

The null hypothesis of this study was that there is no difference in the quality of life measures between patients receiving RCT and STI.

2. REVIEW OF THE LITERATURE

2.1 Oral Health outcome measures

Quality of life is concerned with the extent that a person is able to enjoy the possibilities of life (Raphael, 1994). Instruments that measure quality of life currently focus on the impact of chronic oral diseases (Locker 1988). These instruments utilize seven dimensions of oral health: functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability, and handicap (Locker 1988). The term “quality of life” first was used in the 1920s, but researchers in North America did not take notice of it until the 1960s (Wood-Dauphinee 1999). The development of generic measures began in the early 1970s and continues today. Disease-specific measures have also proliferated. The 1980s and 1990s saw an increase in methodological rigor, and additional emphasis on analytic approaches, interpretation of scale scores, cultural and language issues, as well as on the development of shorter measures (Wood-Dauphinee 1999). In 1977, “quality of life” became a key word in the Medical Subject Headings of the US National Library of Medicine MEDLINE Computer Search System. Following a MEDLINE search, it was reported that between 1966 and 1974 there were 40 references related to quality of life and between 1986 and 1994 there were over ten thousand (Albrecht 1994 Wood-Dauphinee 1999). So, there was an explosion of quality of life research from the mid-80s to through the present. During this time the term health-related quality of life (HRQL) first appears (Ware 1996). HRQL was used to assess the impact of disease and treatment on the lives of patients (Wood-

Dauphinee 1999). One of the earliest health models to assess quality of life was The Quality of Well Being Scale, which was published in 1973, and is a preference weighted measure that was the first to incorporate judgments of value or worth in assessing health status or treatment outcomes (Patrick, et. al. 1973).

Quality of life research began in dentistry, when Locker introduced a conceptual framework for these types of studies in 1988 (Locker 1988). These instruments assess the impact on quality of life of a variety of oral conditions and treatments, such as periodontal disease, tooth loss, and dental implants (Slade 1994). In 2002, Dugas et. al. introduced quality of life study to the field of endodontics (Dugas 2002). In their study of two Canadian populations, they found that subjects reported preoperative factors like pain and sleep disturbance, which impact quality of life, improved after endodontic treatment (Dugas 2002). This improvement was significantly higher in the Toronto population than in the Saskatoon population. Satisfaction among patients was significantly better when endodontic treatment was provided by endodontists (Dugas 2002).

2.2 Oral Health Impact Profile (OHIP)

The capacity of dental clinicians and researchers to assess oral health and to advocate for dental care has been hampered by limitations in measurements of the levels of dysfunction, discomfort and disability associated with oral disorders (Slade 1994). The quality of life instrument was adapted from the OHIP instrument by narrowing the original instrument's 49 items to those that reflect elements that can be related to oral health (Slade 1994). Internal reliability of six subscales was high

(Cronbach's alpha, 0.70-0.83) and test-retest reliability (intraclass correlation coefficient, 0.42-0.77) demonstrated stability (Locker 2004). Validity was examined using longitudinal data from the 60 years old and over cohort where the OHIP's capacity to detect previously observed associations with perceived need for a dental visit (ANOVA, $p < 0.05$ in five subscales) provided evidence of its construct validity (Locker 2004). It was found that the OHIP-14 when used in a rural population that the test was valid, reproducible and consistent (Cohen-Carnerio 2010). The OHIP-14 shows good discriminant and construct validity properties compared to other generic measures such as SF36 (Allen 1999). The SF-36 consists of eight scaled scores, which are the weighted sums of the questions in their section. Each scale is directly transformed into a 0-100 scale on the assumption that each question carries equal weight. The eight sections are: vitality, physical functioning, bodily pain, general health perceptions, physical role functioning, emotional role functioning, social role functioning and mental health (Stevenson 1996).

The Oral Health Impact Profile offers a reliable and valid instrument for detailed measurement of the social impact of oral disorders and has potential benefits for clinical decision-making and research (Locker 2004). The aim of the index is to provide a comprehensive measure of self-reported dysfunction, discomfort and disability arising from oral conditions. It is based on Locker's adaptation of the World Health Organization's classification of impairments, disabilities and handicaps (Locker, 1988). In the WHO model, impacts are organized linearly to move from a biological to a behavioral to a social level of analysis. Slade and Spencer adapted this by proposing seven dimensions of impact of oral condition

(Slade, 1997). Each of the 7 dimensions in the original scale was assessed from questions on the type of problems experienced (a total of 49 questions). A shortened version (OHIP-14) was later developed based on a subset of 2 questions for each of the 7 dimensions (Slade, 1997).

The modified shortened version of the OHIP, the OHIP-14, has been applied to many dental research projects. For instance, the OHIP-14 has been found to be useful for use in edentulous patients (Allen 2002). Another study found that patients that had implant-retained mandibular overdentures report a higher quality of life than those with mandibular complete dentures (Allen 2006). Another study used the OHIP-EDENT, which is a nineteen question survey shortened from the original OHIP, to evaluate edentulous patients (Zani 2009). This study found that patients with implant-supported overdentures and fixed prostheses in the mandible, were equally satisfied with their treatment (Zani 2009). Also, the condition of their prosthesis did not influence individual satisfaction in terms of rehabilitation (Zani 2009).

2.3 Semantic Differential Scale for Satisfaction

Osgood introduced the semantic scale questionnaire in 1952, to measure the connotative meaning of concepts (Osgood 1957). The respondent is asked to choose where his or her position lies, on a scale between two bipolar adjectives (for example: "Adequate-Inadequate", "Good-Evil" or "Valuable-Worthless") (Osgood 1957). Osgood performed a factor analysis of large collections of semantic differential scales and found three attitudes recur (Osgood 1957). Evaluation loads

highest on the adjective pair 'good-bad'. The 'strong-weak' adjective pair defines the potency factor. Adjective pair 'active-passive' defines the activity factor. These three dimensions of affective meaning were found to be cross-cultural universals in a study of dozens of cultures (Osgood 1957).

Presently, the semantic differential is one of the most widely used scales for the measurement of attitudes (Himmelfarb 1993). One of the reasons is the versatility of the items. The bipolar adjective pairs can be used for a wide variety of subjects. And, as such, the scale is nicknamed "the Eveready battery" of the attitude researcher (Himmelfarb 1993).

The semantic differential scale has been used in a variety of dental research projects. In 1974, Koslowsky described the semantic scale and discussed its use in dental research (Koslowsky 1974). The semantic scale has been used to compare age differences in attitudes about oral health (Kiyak 1982). More recently, this scale was used to evaluate undergraduate dental education on the subject of geriatric dentistry and dental student's attitudes toward working with geriatric patients (De Visschere, et al 2009).

2.4 **STI and RCT outcome studies**

Many STI outcome studies have been completed over the last few years. One study evaluated the 5-year survival of single tooth implants (Jung 2007). This meta-analysis of twenty-six studies found that after 5 years, the cumulative incidence of screw or abutment loosening was 12.7% and 0.35% for screw or abutment fracture

(Jung 2007). For supra-structure-related complications, the cumulative incidence of ceramic or veneer fractures was 4.5% (Jung 2007). It was concluded that after an observation period of 5 years, high survival rates for implants and implant-supported single crowns can be expected (Jung 2007). However, biological and particularly technical complications are frequent (Jung 2007).

Another study, also a meta-analysis, evaluated the survival and complication rates of fixed partial dentures (FPDs) after an observation period of at least 5 years (Pjetursson 2004). Meta-analysis of these studies indicated an estimated survival of implants in implant-supported FPDs of 95.4%, 93.9–96.5% after 5 and 92.8% after 10 years (Pjetursson 2004). The survival rate of FPDs supported by implants was 95% after 5 years and 86.7% after 10 years of function (Pjetursson 2004). Only 61.3% of the patients were free of any complications after 5 years (Pjetursson 2004). Peri-implantitis and soft tissue complications occurred in 8.6% of FPDs after 5 years. (Pjetursson 2004). Technical complications included implant fractures, connection-related and suprastructure-related complications (Pjetursson 2004). The cumulative incidence of implant fractures after 5 years was 0.4% (Pjetursson 2004). After 5 years, the cumulative incidence of connection-related complications, like screw loosening or fracture was 7.3% and 14% for suprastructure-related complications, such as veneer and framework fracture (Pjetursson 2004).

The success rate of endodontic therapy, has been studied by multiple researchers. In a large dental insurance database outcome study, it was found that 97.1% of endodontically treated teeth are successful after five to eight years, when success is defined as survival. (Salehrabi, R and Rotsein I. 2004). Another similar

study found that endodontically treated teeth survive two to six years at a 94.4% rate (Lazarksi 2001). It has been determined that these factors improve survival: crown after root canal therapy, both mesial and distal contacts present, the tooth is not an abutment for a removable or fixed prosthesis, and the tooth is a non-molar tooth type (Ng 2010). Other factors that predict successful outcome include absence of pre-op apical radiolucency, root filling with no voids, root filling to within 2mm of radiographic apex, and satisfactory coronal restoration (Ng 2008).

One notable study evaluated the success rate of both RCT teeth and STI and also treatment planning decisions relating to both treatment modalities (Torabinejad 2006). This article found that factors considered in treatment planning, included patient-related issues, such as systemic and oral health, as well as comfort and treatment perceptions (Torabinejad 2006). Also tooth- and periodontium-related factors like pulpal and periodontal conditions, color characteristics of the teeth, quantity and quality of bone, and soft-tissue anatomy were considered (Torabinejad 2006). Finally, treatment-related factors such as the potential for procedural complications, need for adjunctive procedures, and treatment outcomes were all considered when deciding between RCT or STI (Torabinejad 2006). Interestingly, this article found that the survival rates of RCT and STI were very similar and that more than 95 percent of dental implants and teeth that have undergone endodontic treatment remain functional (Torabinejad 2006).

In a systematic review, Torabinejad found that there was 92% survival of endodontically treated teeth at six or more years (Torabinejad 2007). There was a

97% survival of single tooth implant at 6 or more years. Survival is defined as retention of a functional prosthesis, where no interventions were needed. (Torabinejad 2007). For the STI group, the success rate ranged from 92-100% (Polizzi et al 2000) (Anner et al 2000). The Polizzi study evaluated patients 2-4 years after STI placement (Polizzi et al 2000). The Anner study evaluate patients 4-6 years after STI placement (Anner et al 2000). The survival rate for the STI group, ranged from 76-100% (Ottoni et al 2005) (Andersson et al 1998). The Ottoni article evaluated patients 2-4 years after placement and the Andersson article evaluated the patients 4-6 years after placement (Ottoni et al 2005) (Andersson et al 1998). For the RCT group, the success rate ranged from 82-97% (Doyle et al 2006) (Friedman et al 2003). The Doyle study evaluated at 6 years or more after treatment (Doyle et al 2006). The Friedman study evaluated patients at 4-6 years after treatment (Friedman et al 2003). And, for the RCT group, the survival rate ranged from 85-95% (Dammaschke et al 2003) (Waltimo et al 2001). The Damamaschke study evaluated patients at 6 years or more after treatment (Dammaschke et al 2003). The Waltimo article evaluated patient at 4-6 years after treatment (Waltimo et al 2001). So, overall the success rate and survival rate of both NSRCT and STI were comparable and both relatively high.

In another study, a retrospective cross-sectional comparison of initial nonsurgical endodontic treatment and single-tooth implants was conducted (Doyle et al 2006). This study compared 196 implant retained restorations and 196 matched initial nonsurgical root canal treatment (NSRCT) teeth in patients for four possible outcomes: success, survival, survival with subsequent treatment

intervention and failure (Doyle et al 2006). Outcomes were as follows for NSRCT and implant outcomes, respectively: success %: 82.1%/73.5%; survival %: 8.2%/2.6%; success without intervention %: 3.6%/17.9% and % failure: 6.1%/6.1%. Location of the restoration in the mouth did not affect outcome. This study suggests that restored endodontically treated teeth and single-tooth implant restorations have similar failure rates, although the implant group showed a longer average and median time to function and a higher incidence of postoperative complications requiring subsequent treatment intervention.

Also, Iqbal and Kim found in a systemic review that the decision to treat a tooth endodontically or replace it with an implant must be based on factors other than the treatment outcomes of the procedures themselves. Both nonsurgical root canal therapy followed by an appropriate restoration and single-tooth implants are excellent treatment modalities for the treatment of compromised teeth. They also found that there was no significant difference in survival rates between restored root canal-treated teeth and single-tooth implants (Iqbal and Kim 2007).

3. METHODOLOGY

3.1 Study Design

The experimental protocol was approved by the Institutional Review Board, at the University of Illinois at Chicago. (Appendix A, research protocol 2008-1137).

An Axium™ search, through the dental school electronic database, was conducted to find patients that fit the inclusion criteria for the study. The inclusion criteria was that the patient had had RCT or STI placed in a post graduate clinic and a final restoration placed in the undergraduate clinic, 6 months or more prior to the study. The STI and RCT patients were contacted by a researcher in the post graduate prosthodontics clinic and the post graduate endodontics clinic respectively. One hundred seventy three patients were called for the RCT group. The subjects were recruited at routine appointments or by telephone. One patient refused to sign the consent form. Many messages were left on voicemail that were not returned. Other patients said they were too busy (n=6), the phone number was disconnected (n=30), the patient was moving out of town (n=1), the patient hung up (n=1), the patient had a bad experience and did not want to come back to the dental school (n=1), and the patient did not want to come to the dental school without other treatment being rendered (n=1). Also, six patients made an appointment to participate in the research but did not show up. All patients were due for routine recall appointments, which are initiated at least six months after the treatment has been completed. If a patient agreed to participate they reported to the post-graduate endodontics clinic or post-graduate prosthodontics clinic for a recall exam and to complete the questionnaires related to this study. The patients read and

signed a consent form, then completed the modified OHIP-14 and semantic differential scale questionnaire. They then underwent a limited exam of the RCT tooth or STI. Also, routine periapical radiographs of the restored area were taken and interpreted. If additional treatment was required, the patient was informed and additional treatment was scheduled, if necessary.

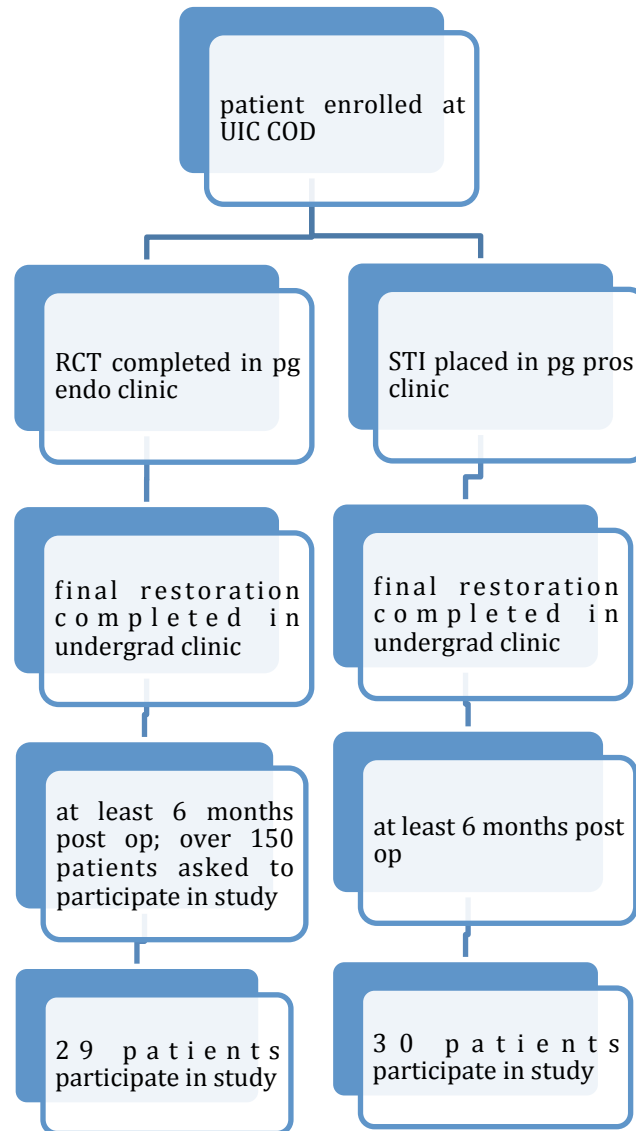


Figure 1. Study model

3.2 **Pilot Study**

Initially, the study was completed on a patient that did not qualify for the study. This patient did not have her final restoration placed in the undergraduate

clinic and therefore did not meet the inclusion criteria. This practice run allowed the interviewer to become familiarized with the process of conducting the study.

3.3. **Statistical Analysis**

Data were collected and coded into a software database (Microsoft Excel 2007, Microsoft). Descriptive analyses were generated, including information on gender, age, site of prosthesis, and recall time. The data were not distributed normally and therefore nonparametric tests were used. The mean and the standard deviation of the modified OHIP-14 and the semantic differential scale were calculated. Based on published data, and with the OHIP-14 summary score as the outcome variable, 23 participants were required in each group to have 80% power to detect a difference of 5% between groups at the 5% level of significance.

Data from both the STI and RCT groups were analyzed using the Mann-Whitney U Test (SPSS for Windows, Version 19, SPSS Inc., Chicago, IL, USA). Significance level for all tests was set at $p = 0.05$.

4. RESULTS

4.1 Demographics

The average age of the RCT patients was 50.8 years old and the average age of STI patients was 53.6 years old. In the RCT group, there were 67% female patients and 33% male patients. In the STI group, 51% were male and 49% were female. The RCT group had more female participants and in the STI group the gender balance was more even.

For location of treatment in the RCT group, most teeth were maxillary posterior teeth (15) and mandibular posterior teeth (12). There were also two maxillary anterior teeth and one mandibular anterior tooth included in the RCT group. In the STI group most implants were placed in the maxillary posterior region (23). There were also three maxillary anterior and three mandibular posterior STIs. In the STI group, there were no implants placed in the mandibular anterior area.

The recall time is defined as the time between the date of the final restoration placement and the date of the recall examination and participation in the study. The RCT group averaged 352 days. And, the STI group averaged 525 days.

The treatment time is defined as the time between the completion of implant placement or endodontic therapy and completion of the final restoration. For the RCT group, the average treatment time was about 267 days. For the STI group, the average treatment was about 232 days.

TABLE I
DEMOGRAPHICS OF RCT AND STI GROUPS

Pt. type	Age (range)	Gender	Location	Recall time (# of days)	Tx. Time (# of days)
RCT	Avg.=50.8 (21-85)	10/M 33% 20/F 67%	XA: 2 XP: 15 NA: 1 NP:12	352	266.71
STI	Avg.=53.6 (24-75)	15/51% M 14/49% F	XA: 3 XP: 23 NA: 0 NP: 3	525	232.14

Location: XA= Maxillary Anterior XP=Maxillary Posterior
NA=Mandibular Anterior NP=Mandibular Posteriors

Recall time= time from final restoration placement until time of recall
Tx. Time= Treatment time, which is time from implant placement or RCT completion until completion of final restoration

4.2 **Modified OHIP-14**

The OHIP-14 is a fourteen-question survey. The results of the survey are included in Table 2. Questions 1, 2, 4, 6, 7, 9 and 12 had a statistically significant difference between the groups. All of these responses showed a trend toward the STI group. The survey allows participants to answer the various questions on a five-point scale: 0 = never, 1 = hardly ever, 2 = occasionally, 3 = fairly often and 4= very often. All fourteen questions for both the STI and RCT groups had a mean between zero and one. In general for both groups, patients reported that they either never or hardly ever experienced the problems listed in the modified OHIP-14 questionnaire.

TABLE II
MODIFIED OHIP-14 RESULTS

OHIP Question (0=never, 1=hardly ever, 2=occasionally, 3=fairly often, 4= very often)	RCT	STI	P value
Q1 Have you had trouble <i>pronouncing any words</i> because of your treatment?	.27± .521	.00± .000	.006*
Q2 Have you felt that your <i>sense of taste</i> has worsened because of your treatment?	.30± .535	.03± .186	.014*
Q3 Have you had <i>painful aching</i> in your mouth?	.60± .932	.17± .468	.054
Q4 Have you found it <i>uncomfortable to eat any foods</i> because of your treatment?	.59± .946	.14± .581	.012*
Q5 Have you been <i>self-conscious</i> because of your treatment?	.37± .964	.21± .819	.274
Q6 Have you <i>felt tense</i> because of problems with your treatment?	.33± .877	.00± .000	.016*
Q7 Has your <i>diet been unsatisfactory</i> because of your treatment?	.53± 1.074	.10± .409	.042*
Q8 Have you had to <i>interrupt meals</i> because of your treatment?	.33± .758	.14± .743	.062
Q9 Have you found it <i>difficult to relax</i> because of your treatment?	.21± .620	.00± .000	.040*
Q10 Have you been a bit <i>embarrassed</i> because of your treatment?	.27± .785	.14± .581	.418
Q11 Have you been a bit <i>irritable with other people</i> because of your treatment?	.20± .610	.14± .581	.435
Q12 Have you had <i>difficulty doing usual jobs</i> because of your treatment?	.20± .407	.00± .000	.012*
Q13 Have you felt life in general was <i>less satisfying</i> because of your treatment?	.23± .679	.14± .516	.435
Q14 Have you been <i>totally unable to function</i> because of your treatment?	.13± .434	.07± .371	.339

*= statistically significant

TABLE III
MODIFIED OHIP-14 RCT

OHIP-14 RCT	Max. value	Min. value	Mean +/-SD	Median
OHIP Question (0=never, 1=hardly ever, 2=occasionally, 3=fairly often, 4= very often)				
Q1 Have you had trouble <i>pronouncing any words</i> because of your treatment?	2	0	.27 ± .521	0
Q2 Have you felt that your <i>sense of taste</i> has worsened because of your treatment?	2	0	.30 ± .535	0
Q3 Have you had <i>painful aching</i> in your mouth?	2	0	.60 ± .932	0
Q4 Have you found it <i>uncomfortable to eat any foods</i> because of your treatment?	3	0	.59 ± .946	0
Q5 Have you been <i>self-conscious</i> because of your treatment?	4	0	.37 ± .964	0
Q6 Have you <i>felt tense</i> because of problems with your treatment?	4	0	.33 ± .877	0
Q7 Has your <i>diet been unsatisfactory</i> because of your treatment?	4	0	.53 ± 1.074	0
Q8 Have you had to <i>interrupt meals</i> because of your treatment?	3	0	.33 ± .758	0
Q9 Have you found it <i>difficult to relax</i> because of your treatment?	3	0	.21 ± .620	0
Q10 Have you been a bit <i>embarrassed</i> because of your treatment?	3	0	.27 ± .785	0
Q11 Have you been a bit <i>irritable with other people</i> because of your treatment?	3	0	.20 ± .610	0
Q12 Have you had <i>difficulty doing usual jobs</i> ?	1	0	.20 ± .407	0
Q13 Have you felt life in general was <i>less satisfying</i> because of your treatment?	3	0	.23 ± .679	0
Q14 Have you been <i>totally unable to function</i> because of your treatment?	2	0	.13 ± .434	0

TABLE IV
MODIFIED OHIP-14 STI

OHIP-14 STI	Max. value	Min. value	Mean +/-SD	Median
OHIP Question (0=never, 1=hardly ever, 2=occasionally, 3=fairly often, 4= very often)				
Q1 Have you had trouble <i>pronouncing any words</i> because of your treatment?	0	0	.00 ± .000	0
Q2 Have you felt that your <i>sense of taste</i> has worsened?	1	0	.03 ± .186	0
Q3 Have you had <i>painful aching</i> in your mouth?	2	0	.17 ± .468	0
Q4 Have you found it <i>uncomfortable to eat any foods</i> because of your treatment?	3	0	.14 ± .581	0
Q5 Have you been <i>self-conscious</i> ?	4	0	.21 ± .819	0
Q6 Have you <i>felt tense</i> ?	0	0	.00 ± .000	0
Q7 Has your <i>diet been unsatisfactory</i> because of your treatment?	2	0	.10 ± .409	0
Q8 Have you had to <i>interrupt meals</i> because of your treatment?	4	0	.14 ± .743	0
Q9 Have you found it <i>difficult to relax</i> because of your treatment?	0	0	.00 ± .000	0
Q10 Have you been a bit <i>embarrassed</i> ?	3	0	.14 ± .581	0
Q11 Have you been a bit <i>irritable with other people</i> because of your treatment?	3	0	.14 ± .581	0
Q12 Have you had <i>difficulty doing usual jobs</i> ?	0	0	.00 ± .000	0
Q13 Have you felt life in general was <i>less satisfying</i> because of your treatment?	3	0	.14 ± .516	0
Q14 Have you been <i>totally unable to function</i> because of your treatment?	2	0	.07 ± .371	0

4.3 **Semantic Differential Scale for Satisfaction**

The semantic differential scale is a seven-part questionnaire. Respondents may answer each question on a ten-point scale. For expense, RCT and STI patients found the procedure to be moderately expensive (6/10). The one question that demonstrated a statistically significant difference was the amount of time the procedure took. RCT patients felt that the procedure took less time than STI patients (5/10 versus 7/10). Both STI and RCT patients found that the procedure was relatively pain free (7/10). The aesthetic results were comparable as well, both highly aesthetic (8/10). There was also good chewing ability for STI and RCT (8-9/10). Both groups found the procedure to be very pleasant (8/10). And finally, the overall experience of both STI and RCT patients was very satisfying (9/10).

TABLE V
SEMANTIC QUESTIONNAIRE RESULT

Semantic	RCT	STI	P value
Q1 expensive (1) inexpensive (10)	6.52± 3.04	6.86± 2.01	.741
Q2 time- consuming (1) quick (10)	6.86± 2.48	4.97± 2.64	.006*
Q3 painful (1) pain free (10)	7.07± 2.60	7.10± 2.70	.951
Q4 tooth had poor aesthetics (1) good aesthetics (10)	8.13± 2.60	8.79± 1.50	.720
Q5 poor chewing ability (1) good chewing ability (10)	8.25± 2.76	9.17± 2.00	.118
Q6 unpleasant (1) Pleasant (10)	7.63± 3.07	8.31± 2.21	.635
Q7 very dissatisfied (1) very satisfied (10)	8.83± 1.81	9.34± 1.20	.344

Questions 1-7 scale 1-10

*=denote statistical difference between groups

**TABLE VI
SEMANTIC RCT RESULTS**

Semantic RCT	Max. value	Min. value	Mean +/- SD	Median
Q1 expensive (1)inexpensive (10)	10	1	6.52± 3.043	6
Q2 time-consuming (1) quick (10)	10	1	6.86± 2.489	7
Q3 painful (1) pain free (10)	10	2	7.07± 2.599	6
Q4 tooth had pooraesthetics (1) good aesthetics (10)	10	1	8.13± 2.596	9
Q5 poor chewing ability (1) good chewing ability (10)	10	1	8.25± 2.757	9
Q6 unpleasant (1) Pleasant (10)	10	1	7.63± 3.068	9
Q7 very dissatisfied (1) very satisfied (10)	10	4	8.83± 1.814	10

TABLE VII. SEMANTIC STI RESULTS.

Semantic STI	Max. value	Min. value	Mean +/- SD	Median
Q1 expensive (1)inexpensive (10)	10	2	6.86± 2.013	7
Q2 time-consuming (1) quick (10)	9	1	4.97± 2.639	5
Q3 painful (1) pain free (10)	10	1	7.10± 2.704	8
Q4 tooth had pooraesthetics (1) good aesthetics (10)	10	5	8.79± 1.497	9
Q5 poor chewing ability (1) good chewing ability (10)	10	1	9.17± 2.001	10
Q6 unpleasant (1) Pleasant (10)	10	1	8.31± 2.206	9
Q7 very dissatisfied (1) very satisfied(10)	10	5	9.34± 1.203	10

4.4 **Overall**

Overall, patients at UIC COD that have had RCT or STI completed in a post-graduate department and restored in an undergraduate clinic are very satisfied with their treatment.

Of the 29 STI patients and 30 RCT patients questioned in this research project, RCT patients felt that their treatment was less time consuming than STI patients.

On the modified OHIP-14 questionnaire, both RCT and STI patients reported that they never or hardly ever experienced the 14 potentially negative aspects of treatment. There were minor differences between the two groups, but both STI and RCT patients were extremely satisfied with treatment.

5. DISCUSSION

Overall, patients are highly satisfied with both STI and RCT at the University of Illinois at Chicago College of Dentistry. As health care providers it is important to take the patient's point of view into consideration when treatment planning so that patients can make the best treatment choice for their particular situation.

The average age of both groups was very similar. The average for the RCT group was 50.8 years old and the STI group was 53.6 years old.

The RCT patients had seventeen teeth treated in the maxillary arch and thirteen in the mandibular arch. Only three of the teeth were anterior teeth. The STI patients had twenty-six upper implants and three lower implants. Only three of the STI patients had anterior implants as well. So the RCT and STI groups had similar proportions for anterior versus posterior treatment areas. But the STI patients had the majority of the implants placed in the maxillary posterior whereas the RCT group had an almost even proportion of maxillary and mandibular posterior teeth treated. It would have been more evenly distributed if the STI group had more mandibular STI patients included in the study. This may affect the results as well because maxillary implants may have different quality of life for patients than mandibular implants.

Another factor affecting this study is the recall time. The definition of recall time for this study is the number of days from completion of the final restoration until the date of the recall. For the RCT group, the recall time averaged 352 days. For the STI group, the recall time averaged 525 days. The difference in average recall time may also contribute to inconsistencies in the results. The STI group, on

average, did not participate in this study until well after a year of the final restoration being placed. The ability of these patients to recall so many aspects of their treatment may be compromised. In another study, the inclusion criteria indicated that the patients needed at least one year of function on their permanent restoration (Gatten et al 2011). In this study, the recall time for the implant group was one to six years and for the RCT group was from one to three and a half years (Gatten et al 2011).

The treatment time for this study is defined as the time from initiation of RCT or STI and placement of final restoration. For the RCT group, the average treatment time was 267 days and for the STI group, the average treatment time was 232 days. So the average time between treatment initiation and completion was similar. It is interesting to note, that on average the STI group was in treatment slightly less than the RCT group. But in the semantic questionnaire, STI group perceived that their treatment was more time consuming than the RCT group, which is discussed below.

On the OHIP-14 questionnaire, both RCT and STI patients reported that they never or hardly experienced the 14 potentially negative aspects of treatment. There were minor differences between the two groups, but both STI and RCT patients were extremely satisfied with treatment. When statistically significant differences were noted between groups, the STI group felt slightly better about the question than the RCT group. Of the fourteen questions, seven questions had a statistically significant difference between groups. Have you had trouble *pronouncing any words*, felt that your *sense of taste* has worsened, found it *uncomfortable to eat any foods*, felt *tense* because of problems, had an *unsatisfactory diet*, found it *difficult to*

relax, and have you had difficulty *doing your usual jobs* all were statistically different between the STI and RCT groups. The OHIP has a five point scale, which 0=never, 1=hardly ever, 2=occasionally, 3=fairly often, 4=very often. For the seven questions that were statistically different, the difference was slight. For instance, in Question 1 the question is about trouble pronouncing words, the RCT group average was .27 and for the STI group, the average was .00. This type of difference may seem magnified by the statistical analysis and shows some significant differences, but may not be clinically significant. The sample size is relatively small, so minor differences may become exaggerated. In a small sample, a few patients that are dissatisfied may skew the results. Some patients may not feel comfortable putting zeros on the form, so this may change the results as well. On the opposite side, there were a few patients that only put zeros for all fourteen patients. These patients may not have taken the time to consider the nuances of each question or have rushed the questionnaire. Also these patients may have had a difficult time recalling the various aspects of their treatment due to the amount of time that elapsed between treatment and the participation in the study. Therefore, the small differences in the OHIP questionnaire should not be highlighted too much.

In the semantic differential scale questionnaire, the only statistically significant difference between the STI and RCT groups was in the perception of how time consuming the treatment process was for the patient. Patients felt that the RCT treatment modality was relatively faster than the STI treatment option. The average time from initiation of STI or RCT and then placement from final restoration was 232 days for STI patients and 267 days for RCT patients. So as an average the

treatment time was similar, but RCT patients actually had a longer treatment time. The perception of quickness with the RCT patients, may be due to the patient perception that the treatment was complete when the RCT was completed. Also, STI patients typically must wait for osseointegration prior to restoration. Whereas with a RCT patient, there will be some type of restorative material in place after treatment, even if it is only provisional. This provisional is likely more comfortable for a patient. So the fact that RCT patients perceive that their treatment time was faster than STI may be due to other factors.

Some incidental findings were reported during the clinical examination portion of the study. For instance, one STI patient reported that “(the) implant is fine, (but it) should have never been put in my mouth. One RCT patient reported that the “appointments are long and time-consuming”. Another RCT patient reported that, “they were supposed to do RCT #3, but #3 and #4 had RCTS”. This patient reported that the endodontic resident didn’t tell her that two root canals were being performed. She states that because of this error, she only got charged for one of the RCTs. And finally, one patient stated that there was “annoying pain (1/10) and slight pain on tapping on the tooth that had a RCT completed.

During the clinical examination some complications were discovered. In the RCT group, recurrent caries was noted along the crown margin of one tooth. An open contact was noted on the crown and adjacent tooth in one case. A STI patient noted that a root canal had to be redone because “a crack occurred”.

As for gender, in the RCT group, 33% were male and 67% were female. The balance of male and female patients in the STI groups was almost even (51% male

and 49% female). It would have been more even, if the RCT group had a more even number of male and female participants, like the STI group. This higher percentage of females in the RCT group, may account for some of the higher pain perceptions in the OHIP-14 questionnaire. It has been reported that females tend to report pain more than males (Otto MW and MJ Dougher 1985).

Also, the gender of the patient and the gender of the provider may skew reporting of pain. For instance, an experiment was conducted that investigated the effect of experimenter gender on the report of pain of male and female subjects (Levine and Simone 1991). In order to evoke gender-related motives, experimenters were selected for their attractiveness (Levine and Simone 1991). Subjects were asked to rate cold presser pain in front of either a male or female experimenter (Levine and Simone 1991). The results indicated that males reported significantly less pain in front of a female experimenter than a male experimenter (Levine and Simone 1991). The difference in female subjects was not significant although they tended to report higher pain to the male experimenter (Levine and Simone 1991).

The number of participants did meet the goal for the power analysis, which was twenty three participants in each group. There were 30 RCT participants and 29 STI participants.

Other types of Quality of Life studies have been completed to evaluate other aspects of dentistry and medicine. For instance, the quality of life of patients that have undergone radiotherapy in the head and neck region, for cancer treatment has been performed. It was found that oral complications following radiotherapy for

head and neck cancer are common and affect quality of life (Epstein 1999). Difficulty chewing or eating was reported by 43% of respondents. Dry mouth was reported by 91.8%, change in taste by 75.4%, dysphagia by 63.1%, altered speech by 50.8%, difficulty with dentures by 48.5%, and increased tooth decay by 38.5% of dentate patients. Pain was common (58.4%) and interfered with daily activities in 30.8%. Mood complaints were reported by approximately half of the patients. Interference of the physical condition social activities was reported by 60%. The frequency of oral side effects correlated with radiation treatment fields and dose (Epstein 1999).

Another study evaluated the effect severe caries has on the quality of life of young children (Low 1999). This study found that in children 35-66 months old, dental caries affected the children's level of pain, quantity of food eaten and sleep habits. So caries had a negative impact on these children's quality of life.

In medicine, Quality of Life studies have been used to assess many issues. In one study, quality of life outcomes are used to assess men that were treated for localized prostate cancer (Litwin, et al 1995). When cancer patients were compared with men of similar age without prostate cancer, differences were seen in the sexual, urinary, and bowel function, but not in general health related Quality of Life measures.

There are some limitations to this study. The main limitation is that this study is retrospective and because of this the patients may not have accurately recalled all information. Also, there was some variability between the STI and RCT

groups. For example, the STI group did not have any participants that had mandibular posterior implants placed.

There may be some recall bias in this study. Recall bias is a systematic error caused by differences in the accuracy or completeness of the recollections retrieved ("recalled") by study participants regarding events or experiences from the past (Last 2000). For instance, another study found a correlation between bitewing radiographs and risk of meningioma (Claus, et al 2012). Claus found that exposure to some dental x-rays performed in the past, when radiation exposure was greater than in the current era, appears to be associated with an increased risk of intracranial meningioma (Claus, et al 2012). The conclusions found in this study may be questioned. In this study, because the patients were asked detailed questions about an event that occurred months ago, they may not have been able to answer all questions accurately. This study may serve as a model for a future prospective study.

6. CONCLUSION

The null hypothesis is rejected. There was a statistically significant difference between STI and RCT, favoring STI. However, this statistically significant difference may not be clinically significant since patients in both groups were very satisfied with quality of life aspects of their treatment.

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APPENDIX

IRB approval

Research

protocol

2008-1137

ADDENDUM

RCT Data sets

RCT Demographics:

Patient ID	Gender M, F	Age	Tooth treated #
1	F	85	25
2	M	55	30
3	F	33	15
4	F	48	2
5	F	23	14
6	F	31	31
7	M	57	30
8	F	16	14
9	M	58	2
10	F	50	3, 4, 5
11	F	47	15
12	M	51	31
13	F	63	7
14	M	73	3
15	M	47	2
16	F	25	7
17	F	62	15
18	F	73	31
19	M	78	3
20	F	42	15
21	F	31	30
22	F	15	3
23	M	64	14
24	F	59	30
25	F	57	2
26	F	50	14
27	M	52	19
28	F	46	3,4
29	M	21	3, 14, 15

RCT OHIP-14:

Patient ID	Q1	Q2	Q3	Q4	Q5	Q6	Q7
1	1	1	2		0		
2	1	1	2	1	1	1	
3	0	0	0	0	0	0	
4	0	0	0	0	0	0	
5	0	0	0	0	0	0	
6	0	0	0	0	0	0	
7	0	0	2	0	0	0	
8	0	0	0	1	0	0	
9	0	0	2	1	4	0	
10	0	0	2	0	0	1	
11	1	1	1	1	0		
12	0	0	0	0	0	0	
13	2	2	3	3	3	4	
14	0	0	0	0	0	0	
15	1	1	2	3	2	2	
16	0	0	0	2	0	0	
17	0	0	0	0	0	0	
18	1	1	1	1	1	1	
19	0	0	0	0	0	0	
20	0	0	0	0	0	0	
21	0	0	0	0	0	0	
22	1	0	1	1	0	1	
23	0	1	1	2	0	0	
24	0	0	0	0	0	0	
25	0	0	0	0	0	0	
26	0	0	0	0	0	0	
27	0	0	0	0	0	0	
28	0	0	0	0	0	0	
29	1	0	0	1	0	0	

RCT OHIP-14, cont.:

Q8	Q9	Q10	Q11	Q12	Q13	Q14
3		3	3	1	3	2
1	0	0	0	1	0	0

0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
2	2	0	1	0	0	0
0	0	0	0	0	0	0
0	0	0	1	1	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
2	3	3	0	0	0	0
0	0	0	0	1	0	0
2	1	1	1	1	2	1
0	0	0	0	0	0	0
0	0	0	0	0	0	0
1	1	1	1	1	1	1
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	1	0	0	0	0
1	0	0	0	0	1	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0

RCT Semantic Questionnaire:

Patient ID	Q1	Q2	Q3	Q4	Q5	Q6	C
1	6	6	5	4	4	6	
2	8	8	9	7	9	8	
3	4	2	5	10	10	5	
4	10	10	10	10	10	10	:
5	10	7	3	4	1	1	
6	10	8	6	5	2	2	
7	4	7	9	9	9	9	
8	10	2	4	5	6	8	
9	9	6	10	10	9	6	:
10	7	8	3	8	8	10	:

11	1	10	6	10	8	10	:
12	10	5	10	10	10	10	:
13	1	4	3	3		3	:
14	10		2	10	10	10	:
15	1	3	5	5	3	3	:
16	6	9	4	8	10	9	:
17	4	5	10	1	10	10	:
18		5	10	6		8	:
19	5	7	7	7	7	7	:
20	6	6	10	10	10	10	:
21	6	9	8	10	10	10	:
22	6	3	2	6	7	8	:
23	3	6	6	8	4	4	:
24	6	10	10	10	10	10	:
25	5.5	8.5	10	10	10	10	:
26	10	1	6	10	10	1	:
27	10	10	9	9	9	9	:
28	10	10	9	10	10	10	:
	9	9.5	6	9.5	10	10	9

STI data sets:

STI Demographics:

	Gender	Age
12	M	45
5	F	61
5	F	42
5	M	62
5	F	24
5	F	37
5	F	45
5	M	44
12	F	66
5	F	65
5	F	33
10	F	30
5	M	64

6	M	71
5	F	46
12	F	76
5	M	64
5	M	63
5	M	49
9	M	49
5	M	75
5	M	45
12	F	47
5	F	53
5	M	59
		52.6
11	F	50
21	M	63
30 (19)	M	76
30	m	58
30	m	48
		53.63225806

STI OHIP-14:

Patient ID	Q		Q3	Q4	Q5	Q	
	1	2				6	7
1	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
5	0	0	0	3	4	0	2
6	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0
14	0	0	2	0	0	0	0
15	0	0	1	0	0	0	0
16	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0
19	0	0	0	1	0	0	0
20	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0
22	0	0	0	0	2	0	0
23	0	0	0	0	0	0	0

24	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0
26	0		1	0	0	0	1
27	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0
29	0	0	1	0	0	0	0

STI OHIP-14, cont.:

Q8	Q9	Q10	Q11
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
4	0	3	3
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0
0	0	1	0
0	0	0	0
0	0	0	0
0	0	0	0
0.16	0	0.16	0.12
0.7838367		0.6118823	0.5878775
18	0	42	38
0	0	0	1
0	0	0	0
0	0	0	0
0	0	0	0

STI Semantic Questionnaire:

Q1	Q2	Q3	Q4	Q5	Q6	Q7
6	5	9	7	10	8	8
10	9	10	10	10	10	10
9	5	10	10	10	8	10
4	7	10	10	10	10	10
7	1	5	6	4	7	5
5	5	5	7	1	10	10
9	3	9	10	10	8	9
4	4	4	8	8	8	9
6	5	9	8	10	7	9
8	6	9	9	9	8	10
6	1	6	8	10	9	9
5	2	1	10	10	1	6
6	5	7	10	10	10	10
5	1	1	9	8	5	10
3	2	5	10	8	7	9
10	2	8	10	10	10	10
6	6	6	9	10	7	9
5	1	9	10	10	10	10
7	4	8	9	10	10	10
7	5	3	10	10	10	10
8	8	5	9	10	10	10
7	7	7	6	9	8	9
7	8	10	10	10	10	10
5	5	7	8	10	10	10
10	5	10	5	10	10	10
6.6	4.48	6.92	8.72	9.08		
1.95789002	2.36502290	2.75257455	1.51437555	2.13931453		
1	3	2	9	2		
7	5	8	10	10	4	10
10	10	10	10	10	10	10
10	10	10	10	10	10	10
7	7	5	7	9	6	9

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