UNIVERSIDADE ESTADUAL DE MARINGÁ

CENTRO DE CIÊNCIAS DA SAÚDE

PROGRAMA DE PÓS-GRADUAÇÃO EM ODONTOLOGIA INTEGRADA

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EFEITO DO PERFIL DE EMERGÊNCIA PROTÉTICO NO NÍVEL ÓSSEO MARGINAL DE IMPLANTES DENTAIS

Dissertação apresentada ao Departamento de Odontologia da Universidade Estadual de Maringá como requisito para obtenção do título de mestre em Odontologia Integrada.

Orientador: Prof. Dr. Maurício Guimarães Araújo

MARINGÁ

2017

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EFEITO DO PERFIL DE EMERGÊNCIA PROTÉTICO NO NÍVEL ÓSSEO MARGINAL DE IMPLANTES DENTAIS

Aprovado em:__/__/__

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2017

Abstract

The aim of this study is to determine the effect of emergence profile on the marginal bone level around dental implants, by analyzing prosthesis angle and bone loss in periapical radiographies.

A total of fifty-three implants periapical radiographies were analyzed using the software ImageJ (Wayne Rasband, National Institutes of Health, USA). In these images, the followed measurements were registered: vertical marginal bone loss, horizontal marginal bone loss, bone loss area, implant - teeth distance, prosthesis angle, contact point - crestal bone distance and contact point - bone/implant contact.

The sample was divided based on prosthesis angle, turning it into three groups, G1 (> 41º), G2 (41º - 61º) and G3 (< 61º). Vertical bone loss in each group was 1.69 ± 0.39 mm, 1.57 ± 0.51 mm and 1.61 ± 0.82 mm respectively, while horizontal bone loss marked 2.11 ± 1.15 mm, 2.47 ± 2.07 mm and 2.79 ± 1.75 mm. Bone loss area results were 1.89 ± 1.07 mm², 1.57 ± 0.51 mm² and 1.49 ± 1.42 mm² for the three groups. The distance from implant to teeth measured was 2.71 ± 1.9 mm, 2.68 ± 1.83 mm and 2.44 ± 1.67 mm. Measurements from contact point got 5.45 ± 1.84 mm, 5.36 ± 1.79 mm in G2 and 6.79 ± 2.47 mm until crestal bone and 4.37 ± 1.27 mm, 5.30 ± 1.76 mm and 5.92 ± 1.67 mm until bone to implant contact. The correlation between variables were analyzed using the Mann-Whitney test for two independent samples. The p-value established was $p<0.05$ as signal of statistically significance difference. Using the Ryan-Joiner Test, variables normality was rejected, therefore the nonparametric Wilcoxon-Mann-Whitney U test for independent samples.

No greater bone loss was found in relation to prosthesis angle, and also the distance from implant to teeth had no correlation with this data. It was noticed however, that even not losing a greater amount of hard tissue apically, the area of bone loss showed significant greater bone loss in prosthesis allocated in group 1. Another record that showed as statistically significant in comparison is the distance from contact point, both until crestal bone and bone to implant contact, a measure that was greater in group 3 than in other groups.

Summary

Introduction

Amongst the most frequently used criteria to define treatment success in implant dentistry, most are directly related to peri-implant bone loss (Papaspyridakos P et al. 2012). The maintenance of bone level around dental implants has been proved a key factor for implant survival rate and success at long term, as peri-implant bone loss may represent a threat to its longevity (Qian et al., 2012) and aesthetic (Hermann *et al.*, 2001). Marginal bone loss has an acceptable mean of 1.5 mm for the first year and 0.1-0.2 mm/year after that (Adell, 1981) (Albrektsson et al, 1986). It was demonstrated that marginal bone loss might represent a threat to long-term success (Qian et al., 2012). The implant condition does not depend on the implant alone, but also on its prosthesis, as in longevity its proper angle is related to soft tissue inflammation and aesthetically, it is a key factor in soft tissue maintenance and black spaces prevention (Croll, 1990). It is known that dental restoration and prosthesis techniques should imitate the conformation of natural teeth, in order to recreate proper functional and aesthetical conditions, as well to make proper hygiene possible for the patient (Croll, 1989). The role of emergence profile, term that first appeared back in 1977, when Kuwata & Stein described how the tooth's crown contour through soft tissue and up to the interproximal contact point and its buccal and lingual sides, is credited as important to be followed in order to maintain soft tissue health (Goiato MC et al, 2011). Croll, in 1989 demonstrated that emergence profiles in teeth tend to be relatively straight, and not angled in a convex or concave manner. It was suggested that emerging perpendicularly from the root should provide means to obtain periodontal health, as also shown by Perel, 1971 who reproduced undercontouring in dogs, which did not affected soft tissue health, and overcountouring, that lead to clinical and histological inflammation and hyperplasia

Various papers about bone loss explore multiple factors that may cause it (Vervaeke S. et al, 2015), as treatment protocol (immediate, one-stage and two-stage delayed loading) (Esposito M. et al, 2010), (Esposito M. et al, 2013); patient smoking status (Hinode D. et al, 2006), (Strietzel FP. et al, 2007), (Vervaeke S. et al, 2012), (Haas R. et al, 1996), (Vandeweghe S. et al, 2011) ; if the implant is placed in the maxilla or in the mandible (Guljé F. et al, 2013); implant length (Guljé F. et al, 2013); implant width (Wagenberg BD. et al, 2013); implant design (cylindrical or conical); prosthetics type (fixed full-arch, fixed partial, single tooth and overdenture) (Cosyn J. et al, 2012);

antagonist teeth (natural, removable denture, implants); previous periodontitis (Ong CT. et al, 2008); and treatment recall compliance.

This pattern of narrower bottom and wider top that is seen on natural dentition can also be found in platform switching concept. In this technique, the abutment is narrower than the implant neck and gets wider the closer it gets to the prosthesis and farther from the crestal bone (Maeda Y et al, 2007), in order to move the implant-abutment junction upwards and away from the marginal bone. It also causes the bacteria placing to move away from the bone, possibly explaining the smaller bone loss attributed to the technique (Cumbo C. et al, 2013). Advantages of this method to bone levels are already well-established, and is speculated that it also benefits the soft tissue surrounding the implant (Dornbush JR et al, 2014). It is not well-known, however, the impact of prosthesis anatomy over dental implants in surrounding bone tissue, and if the angle, that is appears to affect positively both natural teeth and platform switching has any influence when it comes to dental prosthesis over dental implants.

The aim of this study is to determine the effect of emergence profile angle on the marginal bone level around dental implants, by analyzing prosthesis angle and bone loss in periapical radiographies of dental implants.

Material and Methods

The present retrospective clinical study was approved by the Ethic Committee for Research in Humans at State University of Maringá, Brazil, by the number 353.079 (Figure 3). The study included 43 patients that were previously treated with implant-supported crowns and came to the Department of Dentistry at the State University of Maringá for maintenance and supportive therapy during the year of 2010.

The following inclusion and exclusion criteria was implemented.

Inclusion criteria

(a) Patients with equal or more than 18 years old,

(b) Presence of at least one dental implant loaded for at least 1 year.

(c) Single implanted-supported screw retained crowns

(d) Patients enrolled in a maintenance program

(e) Use of external hex implants

(f) Presence of adjacent teeth

(g) Presence of antagonist teeth

Exclusion criteria

(a) Lack of adequate radiological image

(b) Cemented-retained crowns

(c) Oral exposure of the implant shoulder

(d) Presence of or previous treatment for periimplantitis

(e) Uncontrolled diabetes

(f) Any systemic disease that could influence the inflammatory response of the soft tissues

(g) Smoker patients

(h) Presence of bone graft

(i)

A total of fifty-three implants in forty-three patients matched the criteria and were included in the research. Periapical radiographies were taken from each implant using the paralleling angle technique and a standard positioner for this technique. The radiographies were then scanned to a digital image for further analysis in a software, Image J (WayneRasband, National Institutes of Health, USA), pictured in figure 1.

The following measurements were made in each periapical radiograph:

1. Implant shoulder width (Yellow)
    - Know distance

2. MBLv (Marginal Bone Loss, vertical) (Red)
    - Distance, in mm, from implant shoulder until first vertical contact with bone margin
    - Measures extension of possible bone loss, vertically

3. MBLh (Marginal Bone Loss, horizontal) (Green)
    - Distance, in mm, from implant shoulder until first horizontal contact with bone margin
    - Measures extension of possible bone loss, horizontally

4. Bone loss Area (Pink)
    - Area, in mm^3, between implant shoulder and bone margin first contacts (horizontal and vertical) and the bone margin extension underneath these two points
    - Measures area of possible bone loss

5. IT (Implant-Teeth) (Purple)
    - Distance, in mm, from the farther point of the implant shoulder to first contact with adjacent teeth
    - Measures distance from implant to teeth, in order to verify if it follows the recommended minimum of three millimeters

6. Angle (Blue)
    - Angle between implant shoulder line and first contact with farther point of the prosthesis
    - Measures how much space the prosthesis is overlapping the implant shoulder

7. CP-CB (Contact Point – Crestal Bone) (White)

- Distance, in mm, from the contact point until first contact with crestal bone

8. CP-BIC (Contact Point – Bone/Implant Contact) (Black)
   - Distance, in mm, from the contact point until it reaches the first bone to implant contact, the MBLv measure.

A representation of the previous measurements is depicted in figure 2.

Primary variable is prosthesis angle, secondary is bone loss. For all variables found, the standard deviation, median and mean values were calculated (Table 1). The correlation between variables were analyzed using the Mann-Whitney test for two independent samples. The p-value established was $p<0.05$ as signal of statistically significance difference. Using the Ryan-Joiner Test, variables normality was rejected, therefore the nonparametric Wilcoxon-Mann-Whitney U test for independent samples. Using as reference an article by Cooper et al., 2016, who studied bone loss around external hexagon implants in humans and had a sample of 46 implants of this type, sample calculation estimated a minimum n of 42 implants.

Two trained and calibrated examiners performed the radiographic measurements of bone loss in the software ImageJ. To determine the intraobserver error and allow its calibration, both measured the bone loss around 40 implants. Each measurement was performed twice with a fifteen-day interval. An estimate of the intraobserver standard deviation was then determined according to the methodology described by Penarrocha et al. (2004).

Results

The angle found on prosthesis varied from 22.79º to 85.73º and were divided in three groups according to the angle range. G1 (group one) contains prosthesis with angle narrower than 41º; G2 (group two) covers those witch the angle varied from 41º to 60º; G3 (group three) are the ones that had an angle wider than 61º.

Each group's results for every single variable were crossed between them, and showed as following:

- MBLv (Marginal Bone Loss, vertical)

G1 showed 1.69 ± 0.39 mm, G2 1.57 ± 0.51 mm and G3 1.61 ± 0.82 mm. When confronted (G1xG2, G1xG3 and G2xG3) none of them appeared to have statistically significance difference.

- MBLh (Marginal Bone Loss, horizontal)

The distance found was 2.11 ± 1.15 mm in G1, 2.47 ± 2.07 mm in G2 and 2.79 ± 1.75 mm in G3. No statistically significant difference was found in group comparison.

- Bone loss Area

The results for G1 were 1.89 ± 1.07 mm², 1.57 ± 0.51 mm² for G2 and 1.49 ± 1.42 mm² in G3. While no significant difference was found between G1 and G2 or with G2 and G3, it was found when comparing groups 1 and 3, where p-value showed as p=0.02

- Implant – teeth distance

Group 1 had 2.71 ± 1.9 mm, Group 2 2.68 ± 1.83 mm and Group 3 2.44 ± 1.67 mm. Again, no statistic difference was found when comparing the groups.

- Contact point – Crestal bone distance

In G1, the distance was 5.45 ± 1.84 mm, 5.36 ± 1.79 mm in G2 and 6.79 ± 2.47 mm in G3. When comparing the groups, it was found no difference between G1 and G2, but G1xG3 showed p=0.04 and G2xG3 got p=0.003.

- Contact point – Bone to implant contact distance

The distance in Group 1 was 4.37 ± 1.27 mm, 5.30 ± 1.76 mm in Group 2 and 5.92 ± 1.67 mm in Group 3. The comparison between them showed no difference when comparing Group 1 with 2, but showed $p=0.001$ when G1 was put against G3 and $p= 0.02$ between G2 and G3.

Discussion

As far as we know, this is the first analysis to evaluate the effect of the emergence profile angle on the marginal bone level around dental implants. Although it showed no correlation in bone loss length in different types of prosthesis and distances from other teeth, it did found greater bone loss area around the implant neck when wider prosthesis were installed. In addition, the distance from contact point to bone level revealed an important data when it comes to soft tissue maintenance, as the group with wider prosthesis failed to achieve a maximum distance compatible with papilla preservation.

There was no positive correlation between prosthesis angle and vertical/horizontal marginal bone loss, showing that individuals that do not have periimplantitis did not suffer from a greater bone loss by having a wider-angle dental prosthesis if compared to those whose shape matched proposed criteria for the treatment. It is valid to note that this study only evaluated hard tissues around dental implants in correlation to the prosthesis aspects, while it could have shown significant data analyzing soft tissue as well. It has been shown that the presence of a microgap deeper in the bone may not cause additional bone loss (Todescan FF. et al, 2002). In that case, the probable additional bacterial plaque buildup that the prosthesis design may cause would not influence in bone loss apically, since even the presence of bacteria right in the implant interface did not caused it.

However, even if the distance in millimeters showed no difference, it was possible to spot a difference (p=0.02) in bone loss area. The amount of bone that was lost around the implant was significant bigger in group 1 than in group 3, demonstrating that even if a wider emergence profile, or a overcountouring, did not impacted in greater bone loss apically, it did closer to the implant shoulder and around it. Although disputed in the literature, the association between occlusal load and bone loss can be linked to marginal remodeling activity (Chang M. et al, 2013). We speculate that wider prosthesis may produce greater forces and stress around the implant neck than narrower ones, especially during bone healing when the implant is placed with immediate loading.

Another variable that showed no statistically significant difference was the implant - teeth distance, in which all implants were found around the same distance and no correlation to prosthesis angle was found on any of the three groups. This showed that preconized placement distance between implant-teeth and implant-implant was respected in this selected population. (Tarnow DP et al, 2000)

When it comes to contact point, both CP-CB (crestal bone) and CP-BIC (bone to implant contact) showed negative correlation when comparing groups 1 with 2. Nonetheless, both had statistical difference while comparing G1 versus G3 and G2 versus G3. The fact that group three tended to show a greater distance from contact point to bone level is important in determination not of hard tissue, but of soft tissue, more specifically in papilla formation and maintenance (Tarnow, 1992). As known, this distance should be no longer than 5 mm to ensure success in papilla presence, but its exceeded specially in G3, scoring as high as 6.79 ± 2.47 mm.

We would like to acknowledge the limitations of our study. First and foremost, this is a retrospective cohort study, and therefore we cannot observe changes the same way a follow-up can as all of them already occurred in the past and cannot be compared with another period. Secondly, the study is focused only in dental implant periapical radiographies, whereas the presence of clinical data could be useful to correlate hard tissue with soft tissue condition, like plaque and bleed on probing index, presence of keratinized mucosa around dental implants, to ensure the patient is able to brush without discomfort (Souza et al, 2016) and aesthetic evaluation. The ideal condition for optimal results would be a follow-up with clinical and radiographic monitoring. This study is however, valid to the clinical practice as it reminds of the limitations of prosthetic rehabilitation and the importance of respecting them.

Conclusion

Although there was no greater bone loss when measuring distance in millimeters from implant shoulder until first contact with marginal bone, there was a significantly higher amount of bone loss in the area around implant shoulder in prosthesis with wider emergence profile than those with a narrower one.

Another remarkable fact is that narrower shapes tended to have a greater distance from impact point to bone level, therefore badly influencing papilla formation and maintenance.

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Tables & Images

Table 1. Mean, standard deviation (SD) and median values for each variable, divided in mesial an distal sites. In mm (MBLv, MBLh, IT, CP-CB, CP-BIC), º (Angle) and mm^2 (Area).

	Mesial			Distal		
	Mean	SD	Median	Mean	SD	Median
MBLv	1.614	0.746	1.528	1.6	0.664	1.577
MBLh	1.299	0.565	1.205	3.724	1.744	3.537
IT	1.76	1.142	1.462	3.305	1.883	2.959
CP-CB	4.751	1.342	4.531	7.767	2.063	7.577
CP-BIC	4.867	1.363	4.874	6.31	1.66	5.992
Angle	56.481	14.176	58.587	65.817	10.201	67.282
Area	1.487	1.343	1.244	1.559	1.176	1.185

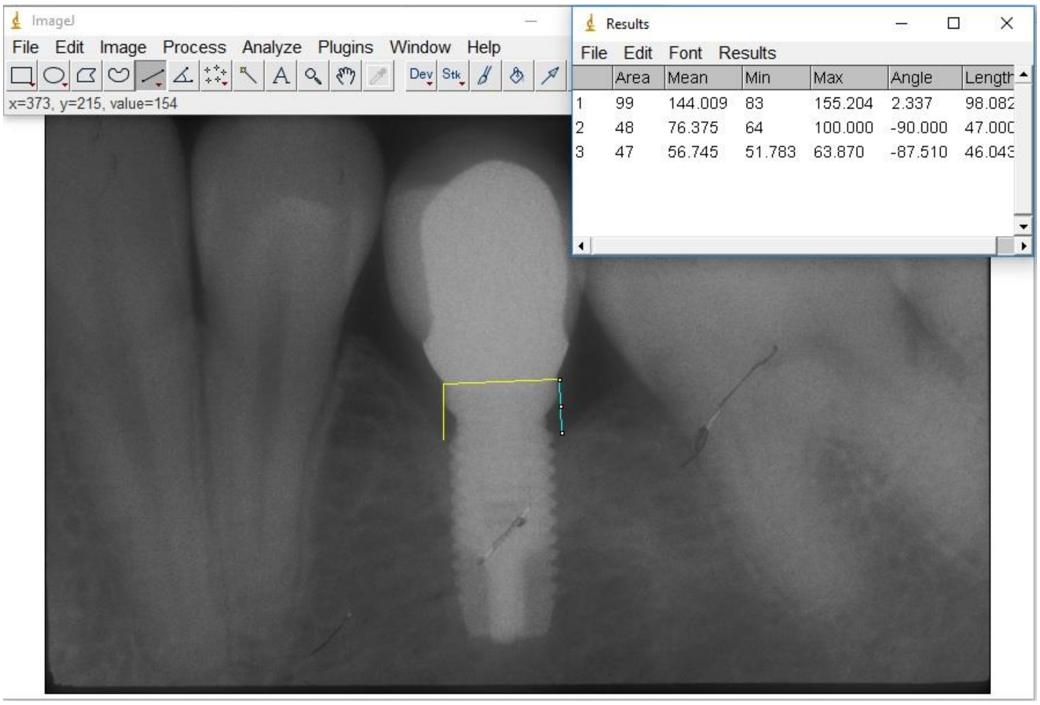

Figure 1 – Software interface during implant measurements

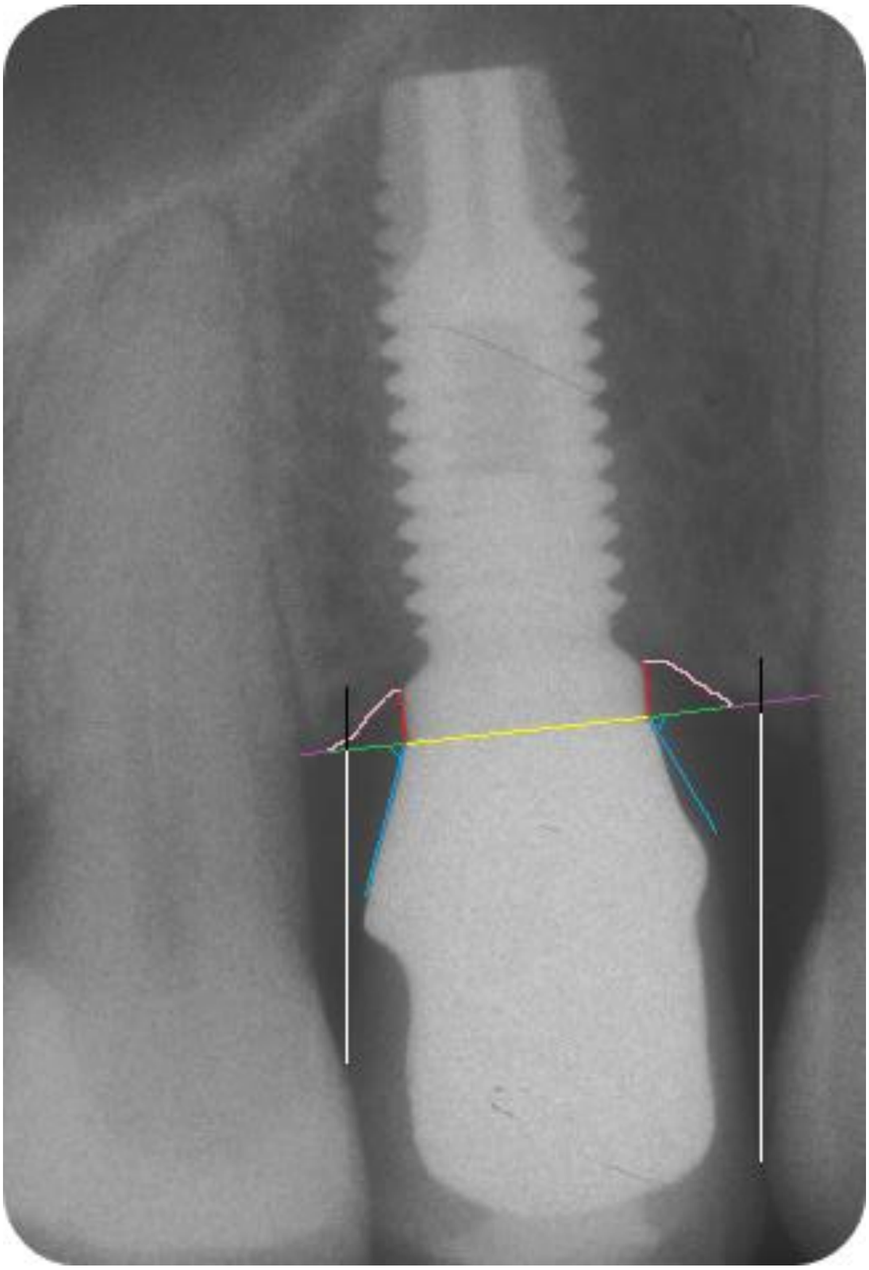

Figure 2- Representation of measurements in colors

DETALHAR PROJETO DE PESQUISA

DADOS DA VERSÃO DO PROJETO DE PESQUISA

Título da Pesquisa: RELAÇÃO ENTRE A DESADAPTAÇÃO DE PRÓTESES SUPORTADAS POR IMPLANTES E O NÍVEL ÓSSEO MARGINAL
Pesquisador Responsável: FLAVIA MATARAZZO
Área Temática:
Versão: 1
CAAE: 17274413.3.0000.0104
Submetido em: 21/06/2013
Instituição Proponente: CCS - Centro de Ciências da Saúde
Situação da Versão do Projeto: Aprovado
Localização atual da Versão do Projeto: Pesquisador Responsável
Patrocinador Principal: Financiamento Próprio

PLATAFORMA BRASIL COORDENADOR PLATAFORMA BRASIL

Comprovante de Recepção: PB_COMPROVANTE_RECEPCAO_172744

DOCUMENTOS DO PROJETO DE PESQUISA

LISTA DE APRECIAÇÕES DO PROJETO

HISTÓRICO DE TRÂMITES

Apreciação	Data/Hora	Tipo Trâmite	Versão	Perfil	Origem	Destino	Informações
PO	08/08/2013 08:52:23	Parecer liberado			Universidade Estadual de Maringá		
PO	08/08/2013 08:52:07	Parecer do colegiado emitido			Universidade Estadual de Maringá	Universidade Estadual de Maringá	
PO	22/07/2013 17:31:06	Parecer do relator emitido			Universidade Estadual de Maringá	Universidade Estadual de Maringá	
PO	22/07/2013 14:51:13	Aceitação de Elaboração de Relatoria			Universidade Estadual de Maringá	Universidade Estadual de Maringá	
PO	19/07/2013 14:34:33	Confirmação de Indicação de Relatoria			Universidade Estadual de Maringá	Universidade Estadual de Maringá	
PO	04/07/2013 14:09:21	Indicação de Relatoria			Universidade Estadual de Maringá	Universidade Estadual de Maringá	
PO	04/07/2013 14:09:02	Aceitação do PP			Universidade Estadual de Maringá	Universidade Estadual de Maringá	
PO	21/06/2013 11:09:38	Submetido para avaliação do CEP		Pesquisador Principal	PESQUISADOR RESPONSAVEL	Universidade Estadual de Maringá	

Figure 3 – Ethics committee approval