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Complications of zygomatic implants: a review of scientific evidence

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Palavras-chave

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Keywords

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Postoperative Complications
Intraoperative Complications

Resumo: Apesar dos avanços tecnológicos dos implantes zigomáticos (ZI) e de seu sucesso comprovado, essa opção de reabilitação é sensível, não uma rotina na prática odontológica, exigindo domínio técnico, experiência cirúrgica e conhecimento anatômico profundo, o que a torna bastante suscetível a complicações. Além disso, pouco se discute sobre essas complicações, imediatas ou tardias, embora sejam conhecimentos essenciais para os cirurgiões que realizam esse procedimento. Objetivo: Responder à questão através de revisão da literatura: "Existem complicações cirúrgicas nos implantes zigomáticos?" Além de discutir as principais intercorrências encontradas. Material e Métodos: A revisão da literatura foi realizada no PubMed / Medline, Cochrane e SciELO usando os descritores: "Complications" or "Failure" and "Zygomatic Implants". Os artigos incluídos foram estudos observacionais que relacionaram ZI e suas complicações. A pesquisa inicial identificou 448 artigos, mas 42 deles que mencionaram complicações associadas à ZI foram considerados neste estudo. Resultados: Houveram 221 complicações nos 2835 implantes instalados (7,78%). A complicação mais comum é sinusite seguida de peri-implantite, problemas na conexão protética, fístula em direção ao implante, parestesia, hematoma, laceração labial, equimoses, penetração da cavidade orbital, aspergilose, penetração intracraniana e hemorragia intraorbital. Dos 2835 ZIs colocados em carregamento imediato ou tardio, 44 (1,5%) foram perdidos. Conclusões: A baixa morbidade deste tratamento para atrofia maxilar, sendo as principais complicações imediatas - hematoma e laceração labial - e as tardias - sinusite e periimplantite. Essas complicações devem ser consideradas na escolha do tratamento de reabilitação e relatadas no pré-operatório aos pacientes.

Complicações de implantes zigomáticos: uma revisão de evidências científicas

Abstract: Despite the technological advances the zygomatic implants (ZI) and its proven success, this rehabilitation option is sensitive, not a routine in dental practice, requiring technical mastery, surgical experience, and in-depth anatomical knowledge, which makes it quite susceptible to complications. In addition, little is discussed about these disorders, whether immediate or late, although they are essential knowledge for the surgeons who perform this procedure. Aim: The objective of the study was to answer the question through literature review: "Are there surgical complications in zygomatic implants?" As well as to argue the main intercurrences found. Material and Methods: The review of the literature was conducted on PubMed/Medline, Cochrane and SciELO using the descriptors: "Complications" or "Failure" and "Zygomatic Implants". The included articles were observational studies that related ZI and yours complications. The initial research identified 448 articles, but 42 of them that mentioned complications associated with ZI were considered in this study. Results: There were 221 complications in the 2835 implants (7.78%). The most common complication is sinusitis followed by peri-implantitis, problems with the prosthetic connection, fistula towards the implant, paresthesia, hematoma, lip laceration, ecchymosis, penetration of the orbital cavity, aspergillosis, intracranial penetration, and intraorbital hemorrhage. Of the 2835 ZIs placed in immediate or late loading, 44 (1.5%) were lost. Conclusions: The low morbidity of this treatment for maxillary atrophy, there are main immediate complication were hematoma and lip laceration and late complications were sinusitis and peri-implantitis. This complication must be considered in the choice of rehabilitation treatment and reported preoperatively to the patients.

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Introduction

The search for techniques with a low degree of morbidity and a high degree of predictability is constant in current Implantology. The zygomatic implant (ZI) is an alternative proposed (Boyes-Varley *et al*., 2003; Brånemark *et al*., 2004) to treat extremely atrophic jaw without the need of reconstructive procedures.

The use of zygomatic implants presents strict advantages such as: shorter treatment time, lower morbidity, no need to use a graft, a decrease of the necessity of many implants to maintain the prosthesis and in cost, and an increase in the stability of obturator prosthesis (Tzerbo *et al*., 2016). The 97% success rate reported by Brånemark *et al*., (2004) motivated researchers (Nakai *et al*., 2003; Malevez *et al*., 2004; Becktor *et al*., 2005), who added new techniques and promising success rates to this technology.

The evolution of this form of treatment allows the rehabilitation of patients within outpatient settings, not requiring hospitalization often through the use of immediate loaded prostheses (Chow *et al*., 2006; Duarte *et al*., 2007; Davo *et al*.,2007).

However, despite the technological advances of this technique and its proven success, this rehabilitation option is sensitive, it isn't a routine in dental practice, requiring technical mastery, surgical experience, and in-depth anatomical knowledge, which makes it quite susceptible to complications. In addition, little is discussed about these disorders, whether immediate or late, although they are essential knowledge for the surgeons who perform this procedure.

The complications from zygomatic fixation can be: 1) immediate: related to post-operative for examples periorbital and conjunctival hematoma, nosebleed, paresthesia and burns on the skin or mucosa of labial commissure region; 2) late - the late complications must be treated very carefully, considering the anatomical site. For examples: loss of fixation and/or osseointegration, bucco sinusal communication, fenestration of the buccal mucosa, sinusitis and sinus pathologies, mucositis and peri-implantitis (Nary-Filho *et al*., 2017).

The aim of the study was to answer the question through literature review: "Are there surgical complications in zygomatic implants?" As well as to argue the main intercurrences found.

Material and methods

The PubMed/Medline, Cochrane Collaboration, and SciELO databases were analyzed to select the studies published in journals using the descriptors: "Complications" or "Failure" and "Zygomatic Implants". Data were organized in tables and qualitatively and quantitatively analyzed, considering $p<0.05$ as a significant value. The articles were classified based on the bias scale of Cochrane. The period analyzed was from 2001 to 2018. The initial research detected 448 articles about ZI. Other articles were also identified from the references and found in other databases. Each article was reviewed. However, only 42 mentioned any complications associated with ZI and were therefore considered in this study.

Results and discussion

The 42 studies included in the present review accounted 2835 ZIs, with 44 implants lost, showing a success rate of 98.4% and a failure rate of 1.5%, within an average time of 34.4 months (2.9 years). There was a prevalence of the female gender (764 cases/ 56.7%). These results undoubtedly suggest that such technique was satisfactory, with excellent clinical outcomes. However, these results must be accepted with great caution due to the absence of research that conducted a follow-up with patients for more than three years.

The success rate of zygomatic implants was higher than the rate of success related to conventional implants in the maxillary anterior region. When both implants were used, there were reports of prostheses that were not installed within the determined time due to loss of conventional implants in this region (Malevez *et al*., 2004; Branemark *et al*., 2004). Nevertheless, the literature on complications related to

zygomatic implants is restricted.

Regarding the loss of zygomatic implants, initially, it was possible to verify that 21 out of the 42 studies presented a success rate of 100% concerning the use of zygomatic implants (Parel *et al*., 2001; Bedrossian *et al*., 2002; Boyes-Varley *et al*., 2003; Nakai *et al*., 2003; Malevez *et al*., 2004; Peñarrocha *et al*., 2005; Farzad *et al*., 2006; Ahlgren *et al*. 2006; Aparicio *et al*., 2006; Bedrossian *et al*., 2006; Chow *et al*., 2006; Peñarrocha *et al*., 2007; Davo *et al*., 2007; Aparicio *et al*., 2008; Davo *et al*., 2008; Aparicio *et al*., 2010; Davo e Pons, 2013; Rajan *et al*., 2014; Garcia *et al*., 2016; D'Agostino *et al*. 2016; Van Camp *et al*., 2018). It was also observed that this rehabilitation modality is a valid option and must be considered for the treatment of extremely atrophic jaw or maxillary defects caused by tumor resection(Branemark *et al*., 2004; Nary-Filho *et al*., 2017).

The technique of titanium implants fixed in the zygomatic bone is recent; its first reports date from the nineties (Nakai *et al*., 2003). However, many techniques or variants were proposed, promising less morbidity, fewer sequels, fewer complications, and early treatment for patients (Boyes-Varley *et al*., 2003; Malevez *et al*., 2004; Aparicio *et al*., 2008). Nonetheless, reports or studies concerning complications associated with ZIs are still insufficient. Al-Nawas *et al*. (2004) reported isolated problems, such as peri-implantitis and sinusitis. However, Aparício *et al*.(2006) comprehensively reported complications related to this rehabilitation modality, associating the satisfaction of patients with their implant-supported rehabilitation.

In this bibliographic review, forty-four implants were lost out of 2835 zygomatic implants installed with immediate or late loading (Vrienlinck *et al*., 2003; Hirsch *et al*., 2004; Branemark *et al*., 2004; Al-Nawas *et al*., 2004; Ferrara & Stella, 2004; Becktor *et al*., 2005; Duarte *et al*., 2007; Pi Urgell *et al*., 2008; Davo, 2009; Sato *et al*., 2010; Reychler *et al*., 2010 Stievenart *et al*., 2010; Migliorança *et al*., 2012; Davo *et al*., 2013; Aparicio *et al*., 2014; Fernandez *et al*., 2014; Bothur *et al*., 2015; Maló *et al*., 2015; Tzerbos *et al*., 2016; Dawood and Kalavresos, 2017). There were 221 reports of complications out of 2835 zygomatic implants, 7.78% of these implants presented a problem that was compromising or not for the prosthetic rehabilitation with the implants (~~Table~~ Quadro 1).

Table 1 - Scientific studies the occurrence of complications in zygomatic implants

	Patients	**Gender**	**Number of Implants**	**Loss**	**Follow-up** (months)	**Compli-cations**	**Type of com-plications**
Parel et al. (2001)	NI	NI	65	0 (100%)	12-144	0	0
Bedrossian et al. (2002)	22	NI	44	0 (100%)	34	0	0
Boyes-Varley et al. (2003)	45	NI	77	0 (100%)	6-30	0	0
Nakai et al. (2003)	9	3 M 6 F	15	0 (100%)	17-47	2	2 P
Vrienlinck et al. (2003)	29	9 M 20 F	67	2 (97%)	24	5	2 P, 1F, 2S
Malevez et al. (2004)	55	14 M 41 F	103	0 (100%)	6-48	0	0

Table 1 - Scientific studies the occurrence of complications in zygomatic implants (cont.).

Hirsch et al. (2004)	76	19 M 57 F	124	3 (98%)	12	30	10P, 6Par, 5 F, 9C
Branemark et al. (2004)	28	NI	52	3 (94%)	26-60	10	8 S, 2 F, * Par
Al-Nawas et al. (2004)	24	NI	37	1 (97%)	10-30	9	9P
Ferrara and Stella (2004)	16	4 M 16 F	25	1 (96%)	6	1	1S
Becktor et al. (2005)	16	6 M 10 F	31	3 (90%)	12-72	15	9P, 6S
Peñarrocha et al. (2005)	21	10 M 11 F	10	0 (100%)	12-18	0	0
Farzad et al. (2006)	11	NI	22	0 (100%)	18-46	9	9P
Ahlgren et al. (2006)	13	6 M 7 F	25	0 (100%)	11-49	4	3H 1LL
Aparicio et al. (2006)	69	22 M 47 F	131	0(100%)	25	29	9P, 6Par, 6H,5LL,3S
Bedrossian et al. (2006)	22	NI	28	0 (100%)	12	0	0
Chow et al. (2006)	5	4 M 1 F	10	0 (100%)	6-10	0	0
Duarte et al. (2007)	12	NI	48	1 (98%)	6-30	1	1H, *P, * Par, *S
Peñarrocha et al. (2007)	21	10 M 11 F	40	0 (100%)	29	1	2S 1E
Davo et al. (2007)	18	6 M 12 F	36	0 (100%)	6-29	2	1P, 1S
Aparicio et al. (2008)	20	11 M 9 F	36	0 (100%)	36-48	0	0
Davo et al. (2008)	42	19 M 23 F	81	0 (100%)	12-42	2	1F e 1S
Pi Urgell et al. (2008)	54	19 M 35 F	101	4 (96%)	1-72	6	4S, 2P
Davo (2009)	24	8 M 16 F	45	3 (93%)	60	7	5S e 2C
Davo et al. (2010)	17	7 M 10 F	68	unfavorable position	12	1	1H 1F*Por
Sato et al. (2010)	1	1M	1	1(0%)	12	1	As
Reychler et al. (2010)	1	1 F	2	2 (0%)	3	1	IP
Stievenart et al. (2010)	20	1 M 19 F	80	3 (96%)	6-40	3	3C
Aparicio et al. (2010)	25	13 M 12 F	47	0 (100%)	24-60	1	1C

Table 1 - Scientific studies the occurrence of complications in zygomatic implants (cont.).

Migliorança et al. (2012)	21	8 M 130 F	40	1 (98%)	96	1	1C
Davo and Pons (2013)	17	7 M 10 F	4	0 (100%)	36	7	1**Por,* 1F, 2S, 3C
Davo et al. (2013)	42	NI	81	1 (99%)	60	6	1P, 5 NI
Aparicio et al. (2014)	22	8 M 14 F	41	2 (95%)	120	2	2P
Fernandez et al. (2014)	80	133 M 111 F	244	1 (99%)	6-48	8	1F, 1Par, 6S
Rajan et al. (2014)	2	NI	4	0 (100%)	24	2	2P
Bothur et al. (2015)	17	NI	58	2 (97%)	108	14	14S
Maló et al.(2015)	352	71 M 281 F	747	7 (99%)	6-84	26	26S
Garcia Garcia et al. (2016)	1	1 F	4	0 (100%)	8-31	4	2H, 2F
D'Agostino et al. (2016)	73	39% M 61% F	133	0 (100%)	13-120	5	5S
Tzerbos et al. (2016)	4	2 M 2 F	20	2 (90%)	48	4	3P, 1F
Dawood and Kalavresos (2017)	1	1F	4	1 (75%)	9	1	1 F
Van Camp et al. (2018)	1	1F	4	0 (100%)	48	1	1 IH
Total **42 studies**	**1349**	**764 (56.7%) F 585 (43.3%) M**	**2835(98.4%)**	**44 (1,5%)**	**35,4**	**221 (7,78%)**	**86S, 61P, 19C, 16F, 13Par, 13H, 6L, 1E, 1Por, 1As, 1IP, 1IH**

Caption:*- the author reports the case, but does not provide accurate information on how many times it occurred; NI – no information; F- Fistula; LL- Lip Laceration; P- Periodontitis, peri-implantitis; Par- Paresthesia, neuralgia; H- hematoma; S- Sinusitis; C- Problems in prothetic connection; E- Ecchymosis; *Por- orbital cavity penetration; As – Aspergylosis; IP - Intracerebral Penetration. IH - intraorbital hemorrhage.

Source: Prepared by the authors.

The studies reported 86 cases of sinusitis (38.91%) (Vrienlinck *et al*., 2003; Branemark *et al*., 2004; Ferrara & Stella, 2004; Becktor *et al*., 2005; Aparicio *et al*., 2006; Duarte *et al*., 2007; Peñarrocha *et al*., 2007; Davo *et al*., 2007; Davo *et al*., 2008; Pi Urgell *et al*., 2008; Davo *et al*., 2009; Davo & Pons, 2013; Fernandez *et al*., 2014; Bothur *et al*., 2015; Malo *et al*., 2015; D'Agostino *et al*., 2016), 61 of periodontitis

/ peri-implantitis (27.6%) (Nakai *et al*., 2003; Vrienlinck *et al*., 2003; Hirsch *et al*., 2004; Al-Nawas *et al*., 2004; Becktor *et al*., 2005; Farzad *et al*., 2006; Aparicio *et al*., 2006; Duarte *et al*., 2007; Davo *et al*., 2007; Pi Urgell *et al*., 2008; Davo *et al*., 2013; Aparicio *et al*., 2014; Rajan *et al*., 2014; Tzerbos *et al*., 2016) , 19 problems in prosthetic connection (8.6%) (Hirsch *et al*., 2004; Davo *et al*., 2009; Stievenart *et al*., 2010; Aparicio *et al*., 2010; Migliorança *et al*.. 2012; Davo and Pons, 2013), 16 cases of fistula towards the implant (7.24%) (Vrienlinck *et al*., 2003; Hirsch *et al*., 2004; Branemark *et al*., 2004; Davo *et al*., 2008; Davo *et al*., 2010; Davo and Pons, 2013; Fernandez *et al*., 2014; Garcia *et al*., 2016 Tzerbos *et al*., 2016; Dawood and Kalavresos, 2017) , 13 cases of paresthesia (5.88%) (Hirsch *et al*., 2004; Branemark *et al*., 2004; Aparicio *et al*., 2006; Duarte *et al*., 2007; Fernandez *et al*., 2014) , 13 of hematoma (5.88%) (Ahlgren *et al*., 2006; Aparicio *et al*., 2006; Duarte *et al*., 2007; Davo *et al*., 2010; Garcia *et al*., 2016), 6 of lip laceration (2.71%) (Ahlgren *et al*., 2006; Aparicio *et al*., 2006), 1 of ecchymosis (0.45%) (Peñarrocha *et al*., 2007), 1 case of penetration of the orbital cavities (0.45%) (Davo *et al*., 2010), 1 case of aspergillosis (fungal sinusitis) (0.45%) (Sato *et al*., 2010), 1 case of intracerebral penetration (0.45%), 1 case of intraorbital hemorrhage (Van Camp *et al*., 2018) and 5 no information (2,26%) (Davo *et al*., 2013), 1 case of intracerebral penetration (0.45%), o autor Reychler *et al*. (2010). There weren't cases of suture dehiscence (soft tissue dehiscence in the cervical portion of two zygomatic implants).

As aforesaid sinusitis is the most frequent and relevant complication after the zygomatic implants insertion (Vrielinck *et al*.,2003; Branemark *et al*., 2004; Ferrara e Stella, 2004; Becktor *et al*., 2005; Aparício *et al*., 2006; Davo *et al*., 2007). Becktor *et al* (2005) related 19.4% cases of sinusitis. Other authors think these results are inexpressive, considering that sinus integrity is not a very relevant concern for them (Branemark *et al*., 2004). The presence of the implant in the sinus cavity only is not synonymous of a predisposition to a sinus infection. (Nary-Filho *et al*., 2017). An interesting and common fact in the studies was the occurrence of late sinusitis. Brånemark *et al*. (2004) reported four symptomatic and four asymptomatic cases in late follow-up.

Out of all cases of complications reported in this review, 61 were related to plaque accumulation in the palatal region. In the literature (Al-Nawas *et al*., 2004*)* that the palatine emergence of zygomatic implants can make hygiene and phonation difficult. In addition to its positioning, anatomy makes the peri-implant deeper favoring bacterial colonization. In an attempt to minimize such complications (difficult cleaning), subsequent modifications have been proposed for this technique (Boyes-Varley *et al*., 2003). Ferrara e Stella (2004) suggested a change in the positioning of the implant, giving greater proximity to the alveolar crest. Boyes-Varley *et al*., (2003) studied an implant with an angle of 55º and positioned more laterally to the maxillary sinus. Finally, Aparício *et al*., (2006) showed 36 implants placed externally to the maxillary sinus, resulting in a decrease between the distances of the prosthetic connection to the alveolar crest. All of the aforementioned studies have improved the hygiene and maintenance of implants (Boyes-Varley *et al.,* 2003; Al-Nawas *et al*., 2004; Ferrara & Stella, 2004; Aparício *et al*., 2006). We could verify the oral rehabilitation provided by the use of the ZIs has an adequate acceptance in the world literature by both patients and rehabilitation dentists (Nakai *et al*., 2003; Duarte *et al*., 2007). Reports of disorders were often restricted to hygiene difficulty and phonetic changes (61 of 221 cases). These problems were minimized over time due to the habit of hygiene becoming a routine.

It is also known that most of these patients may have motor restraints that can make the hygiene control more difficult, and many of them used removable denture implants, which could be removed for hygiene, before the fixed rehabilitation. The patient not being habituated to cleaning the prosthesis inside the mouth can greatly contribute to hygiene difficulty.

Once there is a bone loss, resective osseous surgeries should be indicated to remove periodontal pockets or repair the bone crest around the implants. Al-Nawas *et al*., 2004 found a prevalence of peri-implantitis common bacterium in 9 out of 20 implants assessed. Although authors do not relate it to peri-implantitis,

there are cases in the literature of late oroantral fistulas from the peri-implant region, which required surgical intervention (Vrielinck *et al*.,2003). Al-Nawas *et al.* proposed in 2004 a careful periodontal evaluation of patients undergoing rehabilitation with zygomatic anchors. The authors reported that the zygomatic implant has a depth to the peri-implant probe of 7mm, without alterations most of the time, which could be considered pathological in conventional implants.

The fistula was described in several studies (Vrienlinck *et al*., 2003; Hirsch *et al*., 2004; Branemark *et al*., 2004; Davo *et al*., 2008; Davo *et al*., 2010; Davo and Pons, 2013; Fernandez *et al*., 2014; Garcia *et al*., 2016 Tzerbos *et al*., 2016; Dawood and Kalavresos, 2017). Hirsch *et al.* (2004) diagnosed five fistulas: three before the intermediate connection and two after the intermediate, possibly due to peri-implantitis. The buccal sinus fistula usually requires corrective surgery, which is generally with remnants for its closure; a meatal antrostomy was described with good results (Branemark *et al*., 2004).

Paresthesia was described by four authors that reported 14 cases (Branemark *et al*., 2004; Hirsch *et al*., 2004; Aparicio *et al*., 2006; Duarte *et al*., 2007). The most common symptoms were paresthesia of the upper lip that, in short periods, had complete regression (Branemark *et al*., 2004; Hirsch *et al*., 2004; Aparicio *et al*., 2006; Duarte *et al*., 2007). Branemark *et al.* (2004) associated paresthesia with incision and buccal displacement. Paresthesia seems to be more common when more than one implant is necessary per side (Duarte *et al*., 2007). In cases with four zygomatic implants, two of them on each side the anterior implant needs to emerge in the canine or lateral region. Thus, the anteriorization of the implant may be the cause of labial paresthesia due to transurgical manipulation of the tissues during the detachment and the withdrawal. (Branemark *et al*., 2004).

The hematoma and the extravasation of blood in the tissues is an expected surgical complication due to the trauma caused in the region. The frequency of this complication in our review was 5,88% (13 out 221) (Ahlgren *et al*., 2006; Aparicio *et al*., 2006; Duarte *et al*., 2007; Davo *et al*., 2010; Garcia *et al*., 2016). Treatment is expectant, as it regresses spontaneously in a period of 10 to 15 days. (Aparicio *et al*., 2006). The lip laceration occurred in 2.71% (6 out 221) of the cases. Aparicio *et al*., 2006 reported 5 cases, the authors associated this complication to friction caused by rotary surgical instruments. The treatment of laceration can be performed by suturing.

In the articles used in this review, not much is discussed about problems with prosthetic screws, such as loosening and/or fractures. The studies described problems in prothetic connection ranging from 2,13 to 75% (Hirsch *et al*., 2004; Davo *et al*., 2009; Stievenart *et al*., 2010; Aparicio *et al*., 2010; Davo and Pons, 2013). Among the studies evaluated, only Hirsch *et al*., (2004) reported prosthetic disorders such as screw loosening in 9 of their 76 patients. It is known that prostheses with passive seating, well-adjusted occlusion, and adequate components can reduce the presence of a problem in the connectors.

No relation between sinusitis and tobacco was reported by the authors (Vrielinck *et al*.,2003; Branemark *et al*., 2004; Ferrara e Stella, 2004; Becktor *et al*., 2005; Aparício *et al*., 2006; Davo *et al*., 2007). Corroborating these studies, smokers patients, mild (10 cigarettes per day) or not (+ than 10 cigarettes per day) were included in many studies (Malevez *et al*., 2004; Aparicio *et al*., 2006; Davo *et al*., 2007), but none author related such fact to loss of implants, although a relation may exist mainly in case of risk for periodontal diseases.

Considering that only 44 out of the 2835 implants were lost during follow-up, it can be ensured that this form of rehabilitation is predictable and stable in short to medium term. Being an efficient facial maxillofacial rehabilitation, the ZIs can and should be reported to the patient with atrophic jaw borders as a treatment option. Both benefits and morbidities of this technique should be explained to the patient.

Conclusion

According to this review, despite the low morbidity of this treatment for maxillary atrophy, there are

main immediate complications were hematoma and lip laceration and late complications were sinusitis and peri-implantitis. This complication must be considered in the choice of rehabilitation treatment and reported preoperatively to the patients. Further research is necessary for this area with a more extended follow-up period.

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